MAQUET

Servo-i Ventilator System
Service Manual

CRITICAL CARE

GETINGE

Notes

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Important

1

General

- Service documentation for the Servo-i Ventilator System consists of:
  - User's manual. The User's manual is an indispensable complement to the Service Manual for proper servicing.
  - Service Manual
  - Installation Instructions
  - Spare Parts information.
  - Documentation for all optional equipment included in the Servo-i System is also available.
- The Servo-i Ventilator System is referred to as the **Servo-i** troughout this manual.
- There are two serial number labels on the unit:
  - One label is attached to the Patient Unit close to the supply gas inlets. The serial number stated on this label is the ID number of the Patient Unit. The serial number is also stored in the SW memory as the 'System ID'.
  - One label is attached to the rear side of the User Interface close to the On/Off switch. The serial number stated on this label is the ID number of the User Interface.
- System version number can be found in the Status window on the User Interface. Make sure that the version of the User's manual corresponds to the System version.

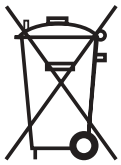
Text inside a box is used to highlight important information.

- In addition to the Important information given here and in the related documents (e. g. in the User's manual), always pay attention to applicable local and national regulations.
- Responsibility for the safe functioning of the equipment reverts to the owner or user in all cases in which service or repair has been done by a non-professional or by persons who are not employed by or authorized by Maquet, and when the equipment is used for other than its intended purpose.

Symbols used in this manual

- **ESD sensitive components**. When handling ESD-sensitive devices, established procedures must be observed to prevent damage.

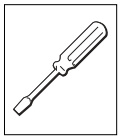
- **Special waste**. Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.



- **Recycling**. Recycle if possible. Recycling facilities may not be available in all areas.

- **Technical training**. Refers to the Technical training supplied by Maquet.

- **Service contract**. Refers to the Service contract supplied by Maquet.



Hazard notices

- Before disassembling or assembling of the Servo-i, make sure that the:
  - On/Off switch is set to Off.
  - Mains power cable is disconnected.
  - Gas supply is disconnected (wall and/or cylinder).
  - Battery modules are disconnected.
  - The Servo-i is cleaned according to instructions in the User's manual, chapter 'Routine cleaning' and chapter 'Regular maintenance', section 'Extended cleaning of inspiratory channel'.
- With power supply connected to the Servo-i, there are energized electrical components inside the unit. All personnel must exercise extreme caution if fault tracing or adjustments are performed with power supply connected and with user interface and patient unit covers removed.

Important

Installation

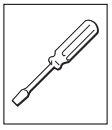
- Only personnel trained and authorized by Maquet shall be permitted to install the Servo-i. The installation and handing over procedures are described in the 'Servo-i Ventilator System – Installation Instructions'.

Functional check

- After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check' according to instructions in the 'Servo-i Ventilator System – User's manual'.

Service

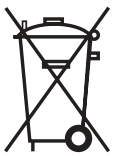
- The Servo-i must be serviced at regular intervals by personnel trained and authorized by Maquet.
  Any maintenance or service must be noted in a log book provided.



- It is recommended that maintenance and service is done as a part of a service contract with Maquet.

- Preventive maintenance must be performed at least once every year as long as the unit is not used more than normal. Normal operation is estimated to correspond to approx. 5.000 hours of operation. Details are found in this Service Manual, chapter ”Preventive maintenance”.
- The Battery modules shall be replaced every three years.
- The internal Lithium batteries (on PC 1771 and PC 1772) shall be replaced every five years.

- Worn-out batteries must be recycled or disposed of properly according to local regulations. Recycle facilities may not be available in all areas.



- Batteries must not be disposed of with ordinary waste. Discard all other disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

- When working with ESD sensitive components, always use a grounded wrist band and a grounded work surface. Adequate service tools must always be used.

To the responsible service personnel

- The contents of this document are not binding. If any significant difference is found between the product and this document, please contact Maquet for further information.
- We reserve the right to modify products without amending this document or advising the user.

- Only personnel trained and authorized by Maquet shall be permitted to perform installation, service or maintenance of the Servo-i.
  Only Maquet genuine spare parts must be used. PC boards (spare parts) must always be kept in a package for sensitive electronic devices. Maquet will not otherwise assume responsibility for the materials used, the work performed or any possible consequences of same.
- The device complies to standards and requirements as stated in the 'Servo-i Ventilator System – User's manual'.

Important

Environmental declaration

Purpose

This environmental declaration is for a Servo-i basic unit including the carrier and one battery.

Letters codes within brackets refers to the Functional Block Diagram in chapter Diagrams.

Components with special environmental concern

Components listed below shall be disposed of in an environmentally safe way.

Printed circuit boards

- PC 1770 Main back-plane
- PC 1771 Control, including a Lithium battery (C)
- PC 1772 Monitoring, including Lithium battery (M)
- PC 1775 Plug-and-Play back-plane (P)
- PC 1777 Panel (U)
- PC 1778 DC/DC & Standard connectors (P)
- PC 1780 Pneumatic back-plane (I)
- PC 1781 Pressure transducer, 2 pcs (T)
- PC 1784 Expiratory channel (F)
- PC 1785 Expiratory channel connector (E)
- PC 1786 Expiratory channel cassette (E)
- PC 1789 Remote alarm connector (A)

Other electronics

- TFT assembly including backlight (U)
- Touch screen (U)
- O_2 cell, containing Pb (I)
- Air module, containing multiple PC boards (I)
- O_2 module, containing multiple PC boards (I)
- AC/DC Converter, containing PC boards (P)
- Expiratory cassette (E)
- Expiratory valve coil (E)
- Safety valve pull magnet (I)

Construction materials

The construction materials used in Servo-i in % of the total weight.

Metal – total 77%

- Aluminium 70%
- Steel, zink, brass 8%

Polymeric material – total 9%

- PA (Polyamide)
- POM (Polyoxymethylene)
- SI (Silicone)
- TPE (Thermoplastic elastomer)
- PUR (Polyurethane)
- ABS (Acrylicnitrilebutadienstyrene)
- EPDM (Ethylenepropylenedienemonomer)
- PTFE (Polytetrafluoroethylene)
- FPM (Fluororubber)
- NBR (Nitrilerubber)
- PP (Polypropylene)
- PVC (Polyvinyl chloride)
- PS (Polystyrene)

Electronics – total 14%

- Accumulators Nickel Metalhydride
- Printed circuit boards, cables etc.

Others – very small amounts

- Sterile filter paper of glass fibre

Important

Articles of consumption

1. Bacteria filter
2. Filters for the gas modules
3. Filter for the inspiration pressure transducer
4. Filter for the O_2 cell
5. Nozzle units for the gas modules
6. Battery modules
7. Lithium batteries
8. Expiratory cassette
9. Expiratory cassette membrane
10. O_2 cell
11. Backlight lamps.

Item 1: Consumption approximately 250 pcs/year.

Items 2 – 5: Changed approx. every 5.000 hours.

Items 6 – 7: Changed approx. every 15.000 hours.

Items 8 – 11: Changed when needed.

Power consumption

The power consumption depends on the operating mode and whether the internal batteries are being fast or trickle charged.

Mode	Fast charging	Trickle charging
In operation	70 W	38 W
Standby	65 W	33 W
Off	35 W	6 W

Noise level

Less than 50 dBA.

Packing materials

The amounts of packing materials will vary depending on customer adaptation.

Materials for packing:

- Loading pallet. Fulfils the USA requirements 7 CFR 319.40 May 25'th 1995.
- Corrugated cardboard
- Stretch film of Polyethylene, PE.
- Shock-absorbing material of expanded polyethylene, EPE, or expanded polypropylene, EPP.
- Clamps of Polyethylene, PE.

Notes

Only personnel trained and authorized by Maquet shall be permitted to perform installation, service or maintenance of the Servo-i.

Make sure to prepare the Servo-i properly before disassembling and assembling. Refer to section 'Hazard notices' in chapter 'Important'.

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

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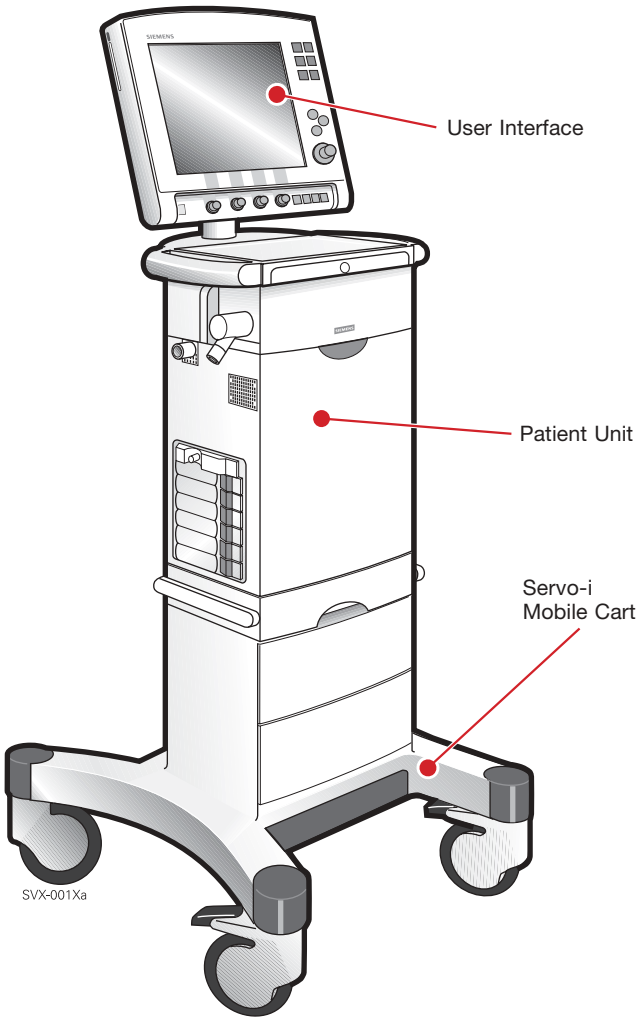

Main units

The Servo-i is available in different main configurations:

- Infant
- Adult
- Universal

These main configurations are as standard equipped with a number of ventilation modes suitable for each patient category. Further ventilation modes can be installed via software Option Upgrades.

The Servo-i can be divided into the following main units:

- User Interface. The User Interface contains all controls used to set the ventilation and monitoring parameters. Ventilation parameters as well as other important information are shown on the User Interface display.
- Patient Unit. The Patient Unit contains pneumatics and electronics for gas supply to the patient. Power supply and battery back-up is also contained in the Patient Unit.

The Control cable connects the User Interface and the Patient Unit.

The Servo-i shown in the illustration is mounted onto the optional Servo-i Mobile cart.

A number of optional equipment can be added to the Servo-i Ventilator System. For further information, refer to the documents listed below.

Servo-i Mobile cart

- Mobile cart with drawers
- Mobile cart without drawers
- Mobile cart for Compressor Mini.

Refer to:

- Servo-i – User's Manual
- Servo-i Mobile cart – Installation Instructions

Servo Ultra Nebulizer, Servo-i

Refer to:

- Servo-i – User's Manual
- Servo Ultra Nebulizer, Servo-i – Installation Instructions

Compressor Mini

Refer to:

- Servo-i – User's manual
- Compressor Mini – Operating Manual
- Compressor Mini – Service Manual
- Compressor Mini – Installation Instructions

Servo-i Holder

Refer to:

- Servo-i – User's Manual
- Servo-i Holder – Installation Instructions

Servo-i Shelf base

Refer to:

- Servo-i – User's Manual
- Servo-i Shelf base – Installation Instructions

Support Arm 177

- Servo-i – User's manual
- Support Arm 177 – Installation Instructions

Gas trolley

- Servo-i – User's manual
- Gas trolley – Installation Instructions

Gas cylinder restrainer

- Servo-i – User's manual
- Gas cylinder restrainer – Installation Instructions

IV Pole, Servo-i

- Servo-i – User's manual
- IV Pole, Servo-i – Installation Instructions

User Interface panel cover

- Servo-i – User's manual
- User Interface panel cover – Installation Instructions

Battery module

- Servo-i – User's manual
- Battery module – Installation Instructions

CO_2 Analyzer module, Servo-i

- Servo-i – User's manual
- CO_2 Analyzer module, Servo-i – Installation Instructions

Humidifier holder and Humidifier

- Servo-i – User's manual
- Humidifier – Operating Manual
- Humidifier holder – Installation Instructions

Alarm output connector

- Servo-i – User's manual
- Alarm output connector – Installation Instructions
- Alarm output connector – Reference Manual

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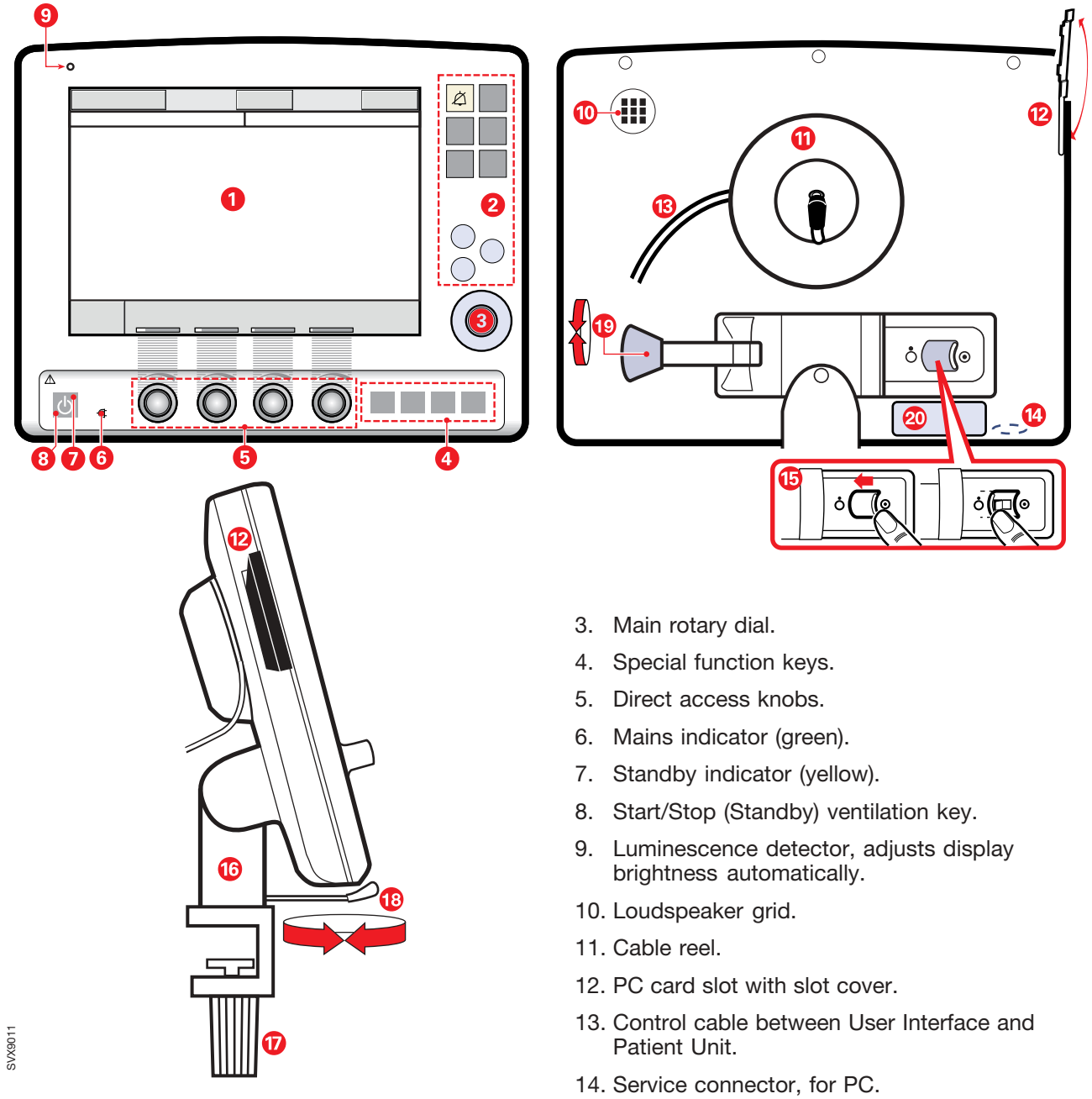


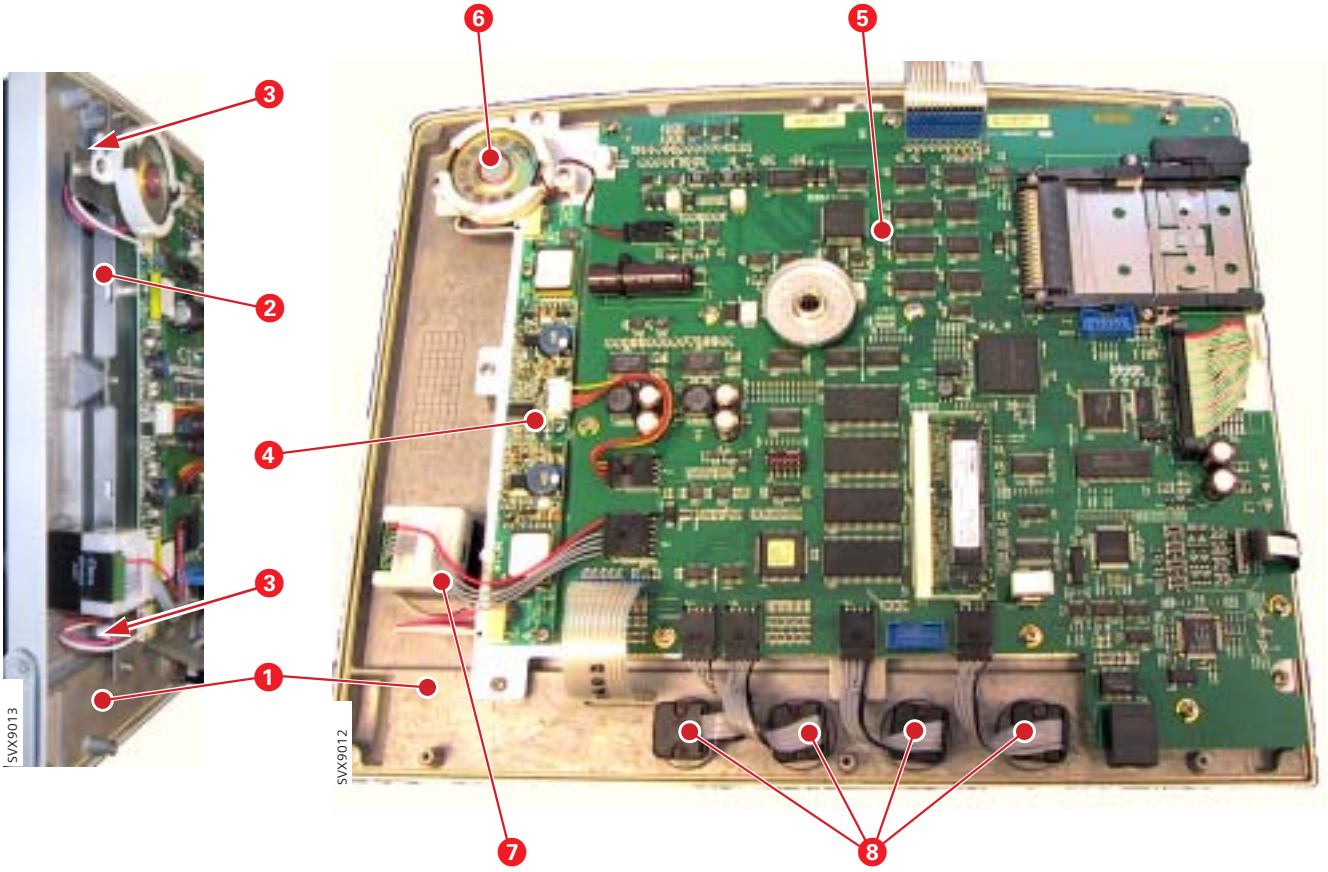
User Interface

The User Interface can be mounted onto the Mobile cart but can also easily be removed from the cart and mounted on the bed post or table/shelf.

The User Interface can be rotated and tilted into a suitable position. Locking levers, mounting devices and some other items are shown in the illustration above.

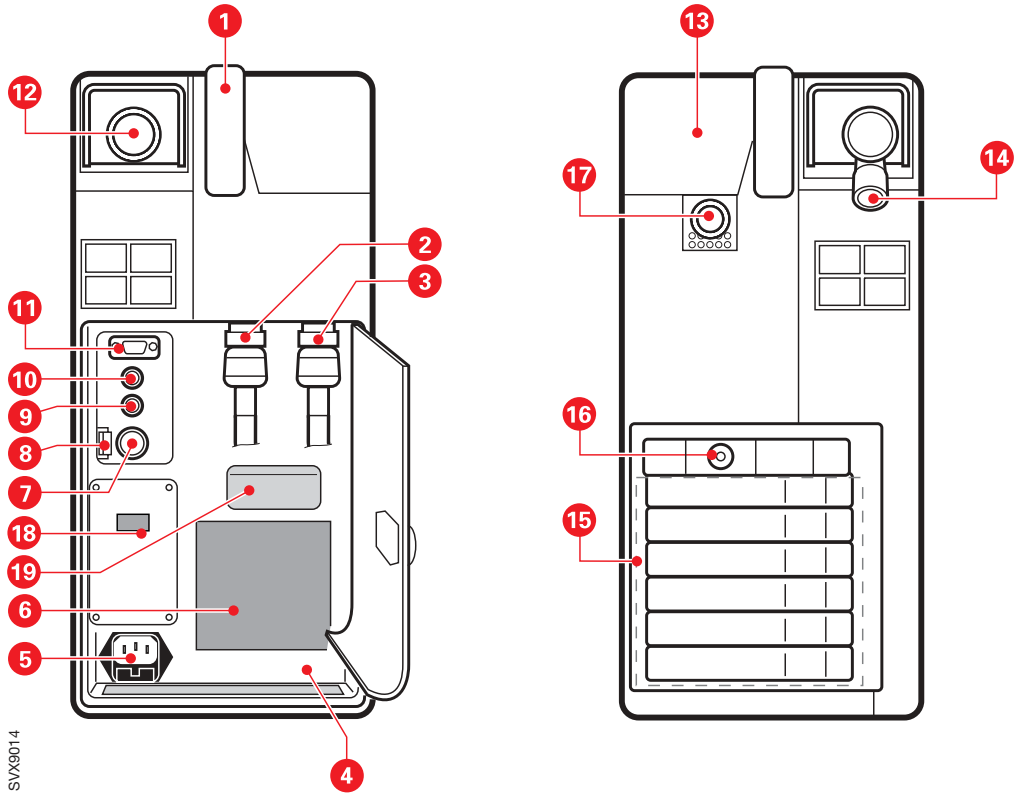
1. Display with touch screen.
2. Fixed keys for immediate access to special windows.
3. Main rotary dial.
4. Special function keys.
5. Direct access knobs.
6. Mains indicator (green).
7. Standby indicator (yellow).
8. Start/Stop (Standby) ventilation key.
9. Luminescence detector, adjusts display brightness automatically.
10. Loudspeaker grid.
11. Cable reel.
12. PC card slot with slot cover.
13. Control cable between User Interface and Patient Unit.
14. Service connector, for PC.
15. On/Off switch.
16. Panel holder
17. Locking screw, alternative mounting
18. Locking arm, rotation
19. Locking arm, tilting.
20. Serial number label. The serial number stated on this label is the ID number of the User Interface. This serial number must always be refered to when ordering service, spare parts, etc for the User Interface.

For further information regarding operation of the User Interface, refer to the User's manual.



When the front panel section is removed from the rear cover, the following parts are accessible:

1. Touch screen assembly, front cover frame included.
2. TFT Display.
3. Backlight lamps.
4. PC board Backlight inverter.
5. PC 1777 Panel including PC Card slot.
6. Loudspeaker.
7. Main rotary dial (rotary encoder with switch).
8. Direct access controls (rotary encoder).

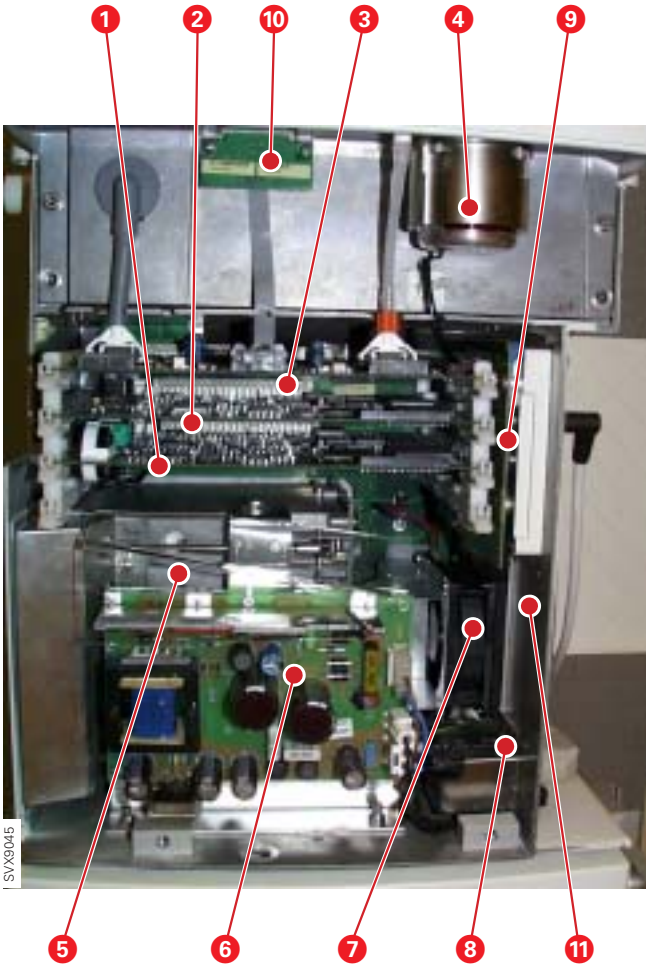


Patient Unit

The Patient Unit can be rotated on and pulled out of the Servo-i Mobile cart. It can also be mounted onto a Servo-i Holder or a Servo-i Shelf base.

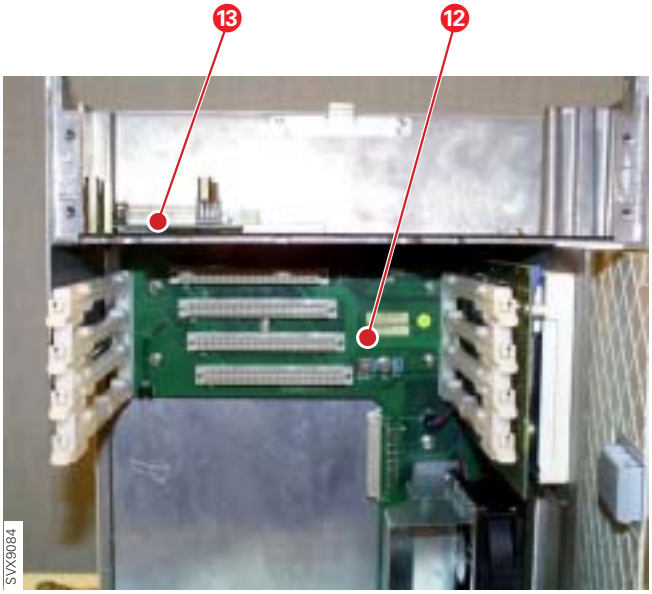
Items accessible from the outside of the Patient Unit are shown in the illustration above.

1. Handle.
2. Gas inlet for Air.
3. Gas inlet for O_2.
4. Equipotentiality terminal.
5. Mains supply connector incl. fuses F11 and F12.
6. Internal fan with filter.
7. Connector for external +12V DC power supply.
8. Fuse F1 for external +12V DC power supply.
9. Optional connector.
10. Control cable connector.
11. 9-pole serial port for data communication (RS- 232).
12. Expiratory outlet.
13. Inspiratory section cover.
14. Expiratory inlet.
15. Module unit for connecting optional modules, e. g. up to six Battery modules.
16. Connector for Servo Ultra Nebulizer, Servo-i.
17. Inspiratory outlet.
18. Alarm output connector (optional).
19. Serial number label. The serial number stated on this label is the ID number of the unit. This serial number must always be refered to when ordering service, spare parts, software updates/upgrades, etc.



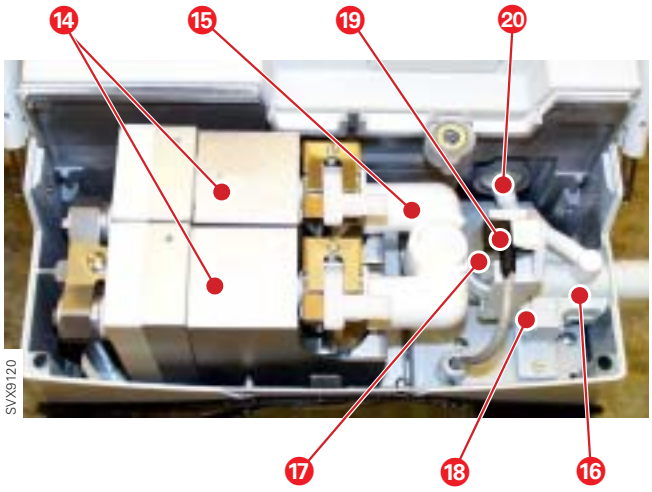
When the Patient Unit front cover is removed, the following parts are accessible:

1. PC 1772 Monitoring.
2. PC 1771 Control.
3. PC 1784 Expiratory channel with the two connected PC 1781 Inspiratory and Expiratory Pressure Transducers.
4. Expiratory valve coil.
5. Module unit including PC 1775 Plug-and-play back-plane.
6. AC/DC Converter.
7. Internal fan.
8. Mains supply inlet.
9. PC 1778 DC/DC & Standard connectors.
10. PC 1785 Expiratory channel connector.
11. PC 1789 Remote alarm connector (optional, not shown in the illustration).



12. The PC boards, as listed above are directly or indirectly connected to the PC 1770 Main back-plane.
13. The gas modules, the O_2 cell and the safety valve pull magnet are connected to the PC 1780 Pneumatic back-plane.

2



The upper part of the Patient Unit contains the inspiratory section and the expiratory section.

The main parts of the inspiratory section are the:

14. Two gas modules, Air and O_2, for regulation of the inspiratory gas.
15. Connector muff.
16. Inspiratory pipe with housings for the O_2 cell and for the safety valve.
17. O_2 cell incl. bacteria filter.
18. Safety valve.
19. Temperature sensor (inside the O_2 cell connector).
20. Inspiratory pressure transducer tube incl. bacteria filter, to connect the inspiratory pressure transducer.

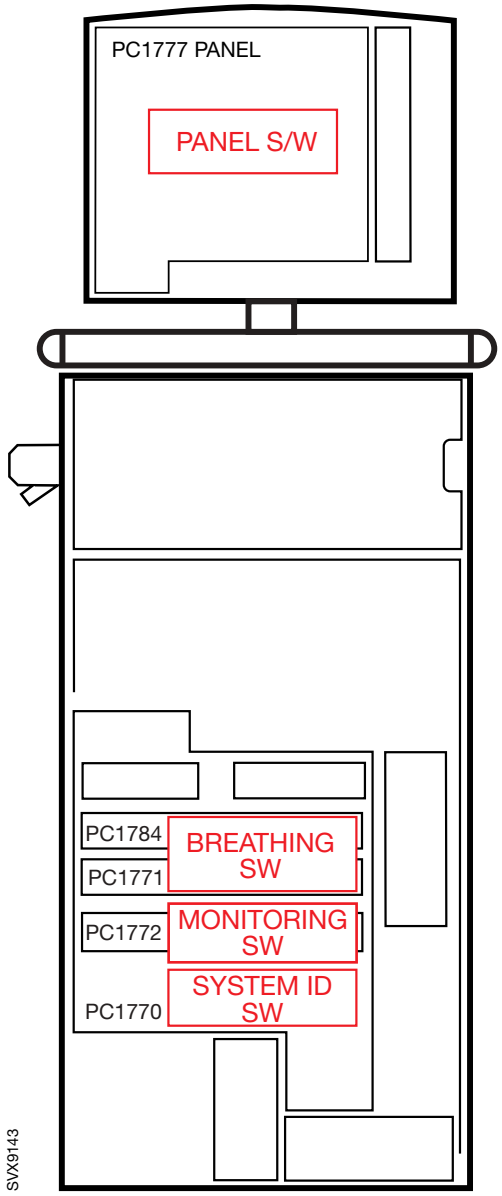
The expiratory cassette (21) is a complete unit and must not be disassembled. It contains the following parts:

- Expiratory inlet with moisture trap.
- PC 1786 Expiratory channel cassette.
- Ultrasonic flowmeter.
- Heating foil to keep a stable temperature in the expiratory gas.
- Pressure transducer connection, incl. bacteria filter, to connect the expiratory pressure transducer.
- Expiratory valve incl. valve membrane.
- Expiratory one-way valve.

The expiratory valve coil, mounted under the expiratory cassette compartment, controls the valve membrane in the cassette.

PC 1786 inside the expiratory cassette is electrically connected to PC 1784 Expiratory channel via PC 1785 Expiratory channel connector.

Servo-i software structure



General

The Servo-i SW installed in the ventilator will contain all available system functionality. The software is separated into different subsystems and stored on some of the PC boards. The separation of the software is handled by the installation program.

The Servo-i software is divided into the following software subsystems:

- Breathing
- Monitoring
- Panel
- System ID

Breathing

The Breathing SW controls the delivery of gases to the patient. This subsystem is responsible for the breathing system, that is:

- Ventilation control and regulation
- Inspiratory channel
- Expiratory channel
- Nebulizer control (software option)

The Breathing SW is stored on PC 1771 Control and PC 1784 Expiratory Channel. New software can be installed via a System SW Update. The System SW must be re-installed if PC 1771 or PC 1784 is replaced.

The Breathing SW is executed by microprocessors on PC 1771 and PC 1784.

Monitoring

The Monitoring SW controls all monitoring and alarm functions in the system, including trends of measured values. Events, such as alarms and change of settings will also be logged.

The Monitoring SW is stored on PC 1772 Monitoring. New software can be installed via a System SW Update. The System SW must be re-installed if PC 1772 is replaced.

The Monitoring SW is executed by the microprocessor on PC 1772.

Panel

The Panel SW controls all user interaction, as well as software updating to all subsystems via the PC Card-interface.

The Panel SW is stored on PC 1777 Panel. New software can be installed via a System SW Update. The System SW must be re-installed if PC 1777 is replaced.

The Panel SW is executed by the microprocessor on PC 1777.

System ID

The System ID SW is a configuration file, stored on PC 1770 Main Back-Plane, that is unique for each ventilator. The System ID SW will enable the functions selected for this ventilator.

To change the functions of the ventilator, a new System ID S/W can be installed via an Option Upgrade.

When replacing PC 1770 Main Back-Plane, a spare part that is factory programmed for the concerned ventilator must be used.

Notes

Only personnel trained and authorized by Maquet shall be permitted to perform installation, service or maintenance of the Servo-i.

Make sure to prepare the Servo-i properly before disassembling and assembling. Refer to section 'Hazard notices' in chapter 'Important'.

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

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About this chapter

This text refers to the Functional Main Blocks diagram in chapter 'Diagrams'.

Memory types used in the Servo-i

There are four different types of memories used in the Servo-i:

- Flash memory. For software storage. Can be upgraded / updated via a System SW Update. Present on PC 1771, PC 1772, PC 1777 and PC 1784.
- RAM. For temporary storage of software and data. Present on PC 1771, PC 1772 and PC 1777.
- Non-volatile memory. RAM with battery back-up. For settings, trends and logs. Present on PC 1771 and PC 1772.
- EEPROM. For PC board information, configuration, calibration data, etc. Present on almost all PC boards and in the O_2 cell.

User Interface

Functional Main Blocks diagram marking: '**U**'

User Interface controls

Setting of different parameter input values is made with the help of the following different interface devices:

- Main Rotary Dial (rotary encoder with switch).
- Direct Access Control, 4 each (rotary encoders).
- Membrane buttons. Integrated parts of the Touch screen assembly.
- Touch screen.

PC 1777 Panel

Some features included on PC 1777 Panel are:

- SIMM (Single In-line Memory Module) mounted on its connector P77. Memory type: SDRAM
- PC Card Slot intended for connection/insert of a PC Card. PC Cards are used to:
  - Download software into the different flash memories situated on PC-boards marked **µP** and into the EEPROM on PC 1770 Main Back-plane.
  - Transfer patient and system data for further transfer to a computer.
  - Service purpose.
- Microprocessor on this board includes control of the functions of the User Interface.
- ID-PROM: The ID information can be read by the Servo-i.
- On/Off switch: Switch to Power up or Power down the Servo-i. Refer to section 'Power supply'.
- Connection for PC (P86): Ethernet port intended for test and service purpose. Connected via a service cable. For future options.
- Microphone used to monitor of sounds from the Loudspeaker.

Note: The System SW must be re-installed if PC 1777 is replaced

Loudspeaker

For generation of sound, e.g. alarm. Connected to P72 on PC 1777 Panel.

The loudspeaker generates different tones with individual sound volumes. At start-up and during Pre-use check the function of the loudspeaker is monitored by the microphone on PC 1777. During operation it is continuously monitored through current sensing.

Backlight Inverter

PC board with driving stage for backlight (lamps) mounted behind the TFT Display. The supply voltage delivered by the Backlight Inverter is 660 V.

The Backlight Inverter is connected to P73 on PC 1777 Panel.

Touch screen assembly

The Touch screen implies the touch function of the front panel screen and is interactive with information displayed on the TFT Display. The front panel frame with the touch screen, membrane buttons and DIM sensor forms the Touch screen assembly and must be handled as one complete part. The DIM sensor measures the ambient light and the screen brightness is automatically adjusted.

TFT Display with Backlight

The TFT Display is a Thin Film Transistor Screen for color display of picture- and alphanumeric data.

The Backlight consists of two fluorescent tubes (lamps) mounted behind the TFT Screen. They are driven from the Backlight Inverter. Estimated lifetime (with acceptable brightness level) for the lamps is 30.000 hours. Using the Field Service System (FSS), a time meter for the lamps can be shown. The time meter must be reset after replacement of the lamps.

Patient unit

Inspiratory section

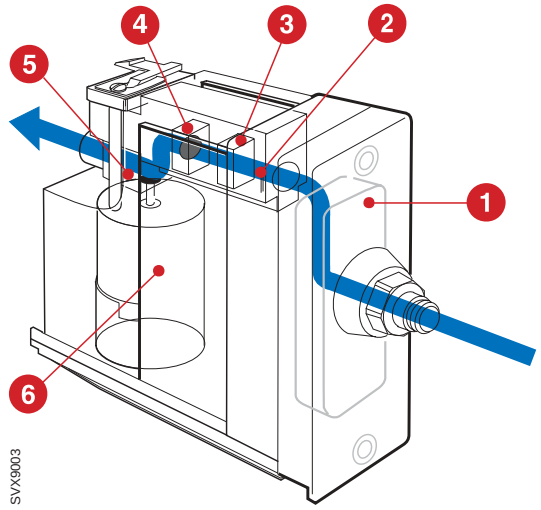
Functional Main Blocks diagram marking: '**I**'

The main block Inspiratory Section conveys the breathing gas from its gas inlets for Air and O_2 supply to the patient breathing system. It comprises the following main functions:

- Gas Modules – Air and O_2.
- Connector Muff.
- Inspiratory Pipe.
- O_2 Cell.
- Temperature Sensor.
- Inspiratory Pressure Tube.
- Safety Valve incl. pull magnet.
- Inspiratory Outlet.
- PC 1780 Pneumatic Back-Plane.

Gas modules – Air and O_2

The Air and O_2 Gas Modules regulates the inspiratory gas flow and gas mixture.



1. Filter
2. Inspiratory valve temperature sensor
3. Supply pressure transducer
4. Flow transducer (Delta pressure transducer and net)
5. Nozzle unit with valve diaphragm
6. Inspiratory solenoid

The Gas Modules are factory calibrated. Each Gas Module must not be disassembled further than described in chapter 'Preventive maintenance'.

Gas inlet

Gas supply is connected to the ventilators gas inlet nipples. The design of the gas inlet nipples and their color markings vary according to the standard chosen.

Gas is to be connected from hospital central gas supply or from gas cylinders. The Air supply may be connected from a compressor for medical air.

Filter

The Filter protects the ventilator from particles in the gas delivered to the Gas Modules. The filter must be replaced during the ”Preventive maintenance”.

The filter housing and the filter cover are provided with matching guide pins. These guide pins prevent mounting of the filter cover (with gas inlet nipple) on the wrong module.

A non-return valve for the gas inlet is located in the filter cover. This valve will suppress short pressure drops in the gas supply.

The non-return valve is also designed to slowly evacuate compressed gas from the module, if the gas supply to the module is disconnected.

Inspiratory valve temperature sensor

The temperature of the supplied gas is measured by the Inspiratory Valve Temperature Sensor. This sensor is situated in the gas flow.

The output signal from this sensor is used to compensate for the gas density variations due to temperature.

Supply pressure transducer

The pressure of the supplied gas is measured by the Supply Pressure Transducer.

The output signal from this transducer is amplified. It is then used to calculate the absolute pressure of the gas to compensate for gas density variations due to pressure.

Flow transducer

The gas flows through a net (resistance) which causes a pressure drop. The pressure is measured on both sides of this net and the differential pressure value is then amplified.

Nozzle unit

The plastic Nozzle Unit contains a valve diaphragm. The valve diaphragm, controlled by the Inspiratory Solenoid, regulates the gas flow through the Gas Module.

The complete plastic nozzle unit must be replaced during the 'Preventive maintenance'.
After replacement, allow the diaphragm to settle during approx. 10 minutes before gas pressure is connected to the Gas Module.

Inspiratory solenoid

The gas flow through the Gas Module is regulated by the Inspiratory Solenoid via the Nozzle Unit.

The current supplied to the solenoid is regulated so that the gas module will deliver a gas flow according to the settings on the User Interface.

Gas module key

The Gas Modules are provided with a mechanical key to prevent that the module is mounted in the wrong slot.

The key consists of a plastic guide mounted underneath the module and a corresponding guide mounted in the patient unit.

ID PROM

Each Gas Module is provided with an ID-PROM. The ID information can be read by the Servo-i System.

Connector muff

The Connector Muff connects the Gas Module outlets to the Inspiratory Pipe inlet.

Inspiratory pipe

The Inspiratory Pipe leads the gas from the Connector Muff to the Inspiratory Outlet.

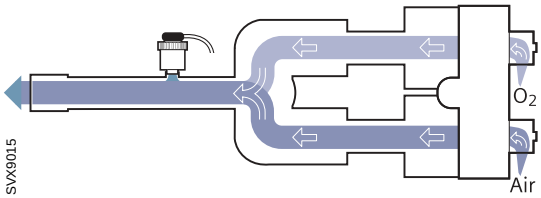
The Inspiratory Pipe comprises:

- Housing and locking lever for the O_2 Cell with its bacteria filter.
- Housing for the Safety Valve.
- Connection for measurement of inspiratory pressure.

The pipe is provided with internal flanges with the purpose to improve mixing of O_2 and Air.

O_2 cell

The O_2 Cell is mounted in a housing on the Inspiratory Pipe and is protected by a bacteria filter.



Maintenance including exchange of bacteria filter according to the User´s manual. The bacteria filter must also be replaced during the 'Preventive maintenance'.

The O_2 cell gives an output voltage proportional to the partial pressure of oxygen inside the Inspiratory pipe. At constant ambient pressure this output is proportional to the O_2 concentration in percent.

In each O_2 cell, the output signal will stay at a fairly constant level usually within 10–17 mV in normal air and at standard barometric pressure during the life time of the cell.

The life time of the cell is affected by the O_2 concentration. With a concentration (at the cell) in % and expected cell life time in hours the following applies at 25°C (77°F):

O_2 Conc. x Expected cell life = 500 000% hours.

The O_2 cell is automatically calibrated each time a Pre-use check is performed (if O_2 is connected to the ventilator).

If the ventilator has continually been in use for a long time, the measured O_2 concentration may drop due to normal degradation of the O_2 cell. This will activate a nuisance alarm. For further information, refer to the User's manual, chapter section 'O_2 cell adjustment'.

Note: Pre-use check is recommended to use to calibrate the O_2 cell.

An ID PROM is integrated into each O_2 cell. Its ID information and remaining lifetime can be read by the Servo-i.

Temperature sensor

A Temperature Sensor is integrated into the connector on top of the O_2 Cell. This sensor measures the temperature inside the Inspiratory Section.

The output signal, corresponding to the temperature in the Inspiratory Section, is used for regulation of the Internal Fan. The electronics for this regulation is located on PC 1775 Plug-and-play back-plane.

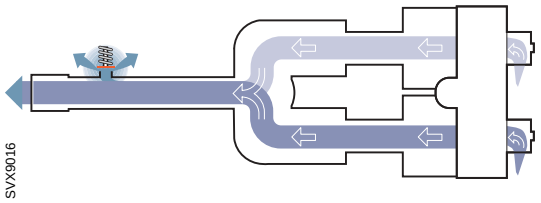
Inspiratory pressure tube

The Inspiratory Pressure Tube connects the Inspiratory Pipe with the Inspiratory Pressure Transducer. A bacteria filter protects the pressure transducer on PC 1781 Pressure Transducer from contamination.

Maintenance including exchange of bacteria filter according to User´s manual. The bacteria filter must also be replaced during the 'Preventive maintenance'.

Safety valve

The movable axis of the Safety Valve Pull Magnet controls the opening and closing of the safety valve membrane in the Inspiratory Pipe. The pull magnet is electrically activated (closed) from the main block Expiratory Channel.



When the Safety Valve is not activated, the weight of the pull magnet axis, in combination with the design of the valve membrane, pushes the pull magnet axis downwards. This actuates the Safety Valve to be opened and the inspiratory gas is let out from the Inspiratory Pipe via the Safety Outlet thus enabling a decrease in the inspiratory pressure. The Safety Outlet is covered by a plastic grid.

This is normal safety (pop-off) function.

The opening conditions for the safety valve are:

- The ventilator is switched Off or Standby.
- The pressure inside the inspiratory pipe is 5 cm H_2O above the preset Upper Pressure Alarm limit. This condition is controlled by the Monitoring subsystem.
- The pressure inside the inspiratory pipe is 7 cm H_2O above the preset Upper Pressure Alarm limit. This condition is controlled by the Breathing subsystem.
- The pressure inside the inspiratory pipe is above 117 ±7 cm H_2O. This is an extra safety function and this situation will normally not occur.
- The safety valve will also be opened by some other alarms, e. g. the Out of gas-alarm.

During startup, the pull magnet is electrically activated so that the pull magnet axis is pushed up (with a clicking sound). This is the normal operational position of the pull magnet; the Safety Valve is normally kept closed.

The safety valve opening pressure is calibrated to 117 ±3 cm H_2O during each Pre-use check.

Inspiratory outlet

22 mm / 15 mm tube connector for the inspiratory tube of the patient breathing system.

PC 1780 Pneumatic back-plane

Interconnecting board including connectors for cables to the Gas Modules as well as to the Safety Valve and to the O_2 Cell and the Temperature Sensor.

Expiratory section

Functional Main Blocks diagram marking: '**E**'

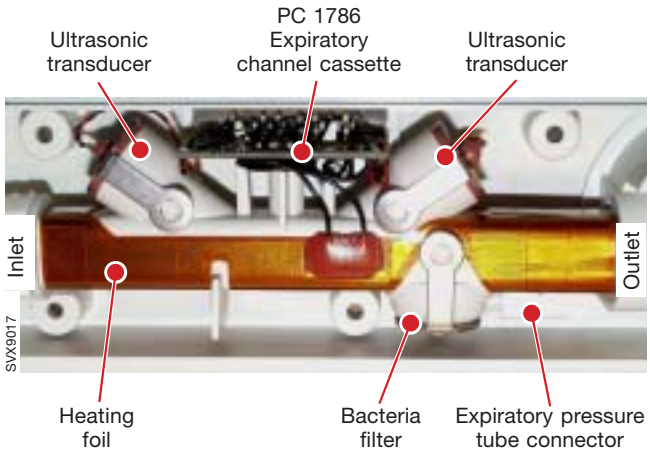
The main block Expiratory Section conveys the breathing gas from the patient breathing system to the Expiratory Outlet. It comprises:

- Measurement of expiratory flow
- Connection for measurement of expiratory pressure.
- Controlling element for the regulation of expiratory pressure.

Expiratory cassette

The expiratory gas conveying parts and PC 1786 Expiratory Channel Cassette are integrated into one part – the Expiratory Cassette – which can be easily removed for cleaning or exchange. See Servo-i Ventilator System – User's manual.

The expiratory cassette can be interchanged between different Servo-i systems. A Pre-use check is always required after exchanging the expiratory cassette.



Expiratory inlet

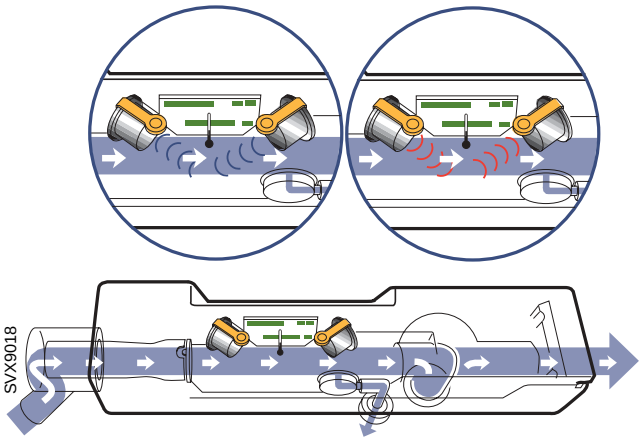
22 mm / 10 mm tube connector for the expiratory tube of the patient breathing system. The inlet is designed to make condensed water drip out and allow use of a water trap for such water to be collected. Expiratory inlet bacteria filter can be connected to protect the cassette from contamination.

Heating foil

An electrical Heating Foil applied on the outside of the expiratory pipe where the Ultrasonic Flowmeter is situated. The purpose of the Heating Foil to reduce condensation and maintain a stable temperature in the expiratory gas.

Ultrasonic flowmeter

The Ultrasonic Flowmeter is a measuring device for the expiratory gas flow, using ultrasound technique with two ultrasonic transducers/recievers.
The measuring process is controlled from the main block PC 1784 Expiratory Channel.



The left hand side transducer is sending out ultrasonic sound that is reflected against the inner wall of the expiratory channel. The ultrasonic sound is recieved by the right hand side transducer now acting as a reciever. The time from sending to recieving ultrasonic sound in downstream expiratory gas flow is measured.

Then the right hand side transducer (earlier recieving) is sending out ultrasonic sound upstream the expiratory gas flow. The ultrasonic sound is recieved by the left hand side transducer now acting as a reciever. The time from sending to recieving ultrasonic sound in upstream expiratory gas flow is measured.

The time difference between the downstream and the upstream time measurements provides flow information.

A temperature sensor inside the cassette measures the expiratory gas temperature. This temperature measurement is also used when calculating the expiratory flow.

Bacteria filter and expiratory pressure tube

Via a Bacteria Filter inside the cassette, the Expiratory Pressure Tube connects the cassette to the Expiratory Pressure Transducer. The filter and the connector are integrated parts of the cassette. The filter protects the transducer on PC 1781 Pressure Transducer from contamination.

Expiratory valve

The Expiratory Valve consists of a membrane in the cassette that is operated by the axis of the Expiratory Valve Coil. The valve is fully open as long as no power is supplied to the coil.

Operating capacity for the membrane is estimated to 10.000.000 breathing cycles. When this limit is passed or if the membrane for some reason has become defective, it must be replaced. Refer to instructions in chapter 'Disassembling and assembling'.

Remaining operating capacity (in %) for the membrane can be shown in the Status window. Select Status / Exp. cassette to check 'Remaining membrane capacity'. The operating capacity meter must be reset after replacement of the membrane.

Expiratory valve coil

The movable axis of the Expiratory Valve Coil controls the opening of the Expiratory Valve by pushing the valve membrane into desired position. The power supply to the coil is regulated so that the remaining pressure in the patient system, towards the end of the expiration time, is kept on the PEEP level according to front panel setting.

Expiratory outlet with expiratory one-way valve

The gas from the patient system leaves the ventilator via this Expiratory Outlet. Backflow via the cassette is prevented by the Expiratory One-Way Valve. Its rubber membrane and valve seat are integrated parts of the Expiratory Outlet.

PC 1786 Expiratory channel cassette

The PC 1786 Expiratory Channel Cassette is a connection board, integrated into the Expiratory Cassette, for the Ultrasonic Flowmeter and for the Heating Foil. It connects to PC 1785 mounted in the expiratory cassette compartment.

Includes an ID PROM. The ID information can be read by the Servo-i System.

PC 1785 Expiratory channel connector

The PC 1785 Expiratory Channel Connector is a connector board including signal filters that is mounted in the expiratory cassette compartment. It connects to PC 1786 mounted in the Expiratory Cassette when the cassette is docked to the expiratory cassette compartment.

PC 1770 Main back-plane

Interconnection board for the PC boards in the lower part of the patient unit.

The ventilators System ID (Serial No.), configuration, time stamp for preventive maintenance, etc, is stored in an EEPROM on PC 1770. Thus, when replacing PC 1770, a spare part that is factory programmed for the concerned ventilator must be used.

As the preventive maintenance time stamp will be reset when replacing PC 1770, a new time stamp must be set via the Biomed menu. In order to make this new time stamp correct, the preventive maintenance must be performed. Refer to chapter 'Preventive maintenance'.

Pressure transducers

Functional Main Blocks diagram marking: '**T**'

PC 1781 Inspiratory pressure transducer

The pressure, conveyed via the pressure tube connected to this block, is led to and measured by its differential pressure transducer. With differential reference to the ambient pressure, the output signal is proportional to the measured pressure thus giving a linear measurement in the range -40 cm H_2O to +160 cm H_2O.

Technical limitation: Pressure exceeding ±400 cm H_2O must be avoided.

Includes an ID PROM. The ID information can be read by the Servo-i System.

PC 1781 Expiratory pressure transducer

Function identical to PC 1781 Inspiratory Pressure Transducer.

PC 1784 Expiratory channel

Functional Main Blocks diagram marking: '**F**'

The main block Expiratory channel comprises microprocessor control to achieve measurement of expiratory flow. The output signal Exp. Flow is used in the main block Control.

Electronics including microprocessor (**µP**) for handling of:

- All electronic connections to and from the Expiratory Section functions.
- Measurement of airway pressures in both Inspiratory Section and Expiratory Section.
- Control of the Safety Valve functions in the Inspiratory Section.

A thermistor on PC 1784 monitors the temperature inside the Patient Unit. An alarm is activated if the temperature is 77 ±5 °C (170 ±9 °F) or higher.

Includes an ID PROM. The ID information can be read by the Servo-i System.

Note: The System SW must be re-installed if PC 1784 is replaced.

PC 1771 Control

Functional Main Blocks diagram marking: '**C**'

The main block Control comprises microprocessor control of Breathing pattern for all different ventilation modes.

Electronics including microprocessor (**µP**) control to achieve:

1. Regulation of Inspiratory flow which is used during inspiration time in Volume Control (VC) mode.
2. Regulation of Inspiratory pressure which can be used during inspiration time in any mode.
3. Regulation of a constant Inspiratory flow which is used during expiration time in all modes.
4. Respiratory timing pattern including frequency as well as distribution of the duration for Inspiration time, Pause time and Expiration time according to front panel settings.
5. Regulation of Inspiratory flow during inspiration time. The desired total Inspiratory flow value according to front panel settings is used to generate the flow reference signals Insp Flow Ref 1 and Insp Flow Ref 2. The level relation between these two flow reference signals depends on the desired O_2 concentration according to front panel setting. Insp Flow Ref 1 and Insp Flow Ref 2 are used for the control of its respective Gas Module (Air and O_2).

Regulation of a constant Inspiratory flow during expiration time: The desired constant Inspiratory flow value is the default or preset Bias flow value (see User's manual).

This desired constant Inspiratory flow value is used to generate the flow reference signals Insp Flow Ref 1 and Insp Flow Ref 2 with the same relation and same handling as described above under "Regulation of Inspiratory flow…" except this occurs during expiration time.

The electronics controlling the optional Servo Ultra Nebulizer is located on PC 1771 Control.

Includes an ID PROM. The ID information can be read by the Servo-i System.

Note: The System SW must be re-installed if PC 1771 is replaced.

A lithium battery on PC 1771 power supplies the internal memory on the PC board. If the battery on PC 1771 is disconnected or if the battery voltage is too low, user default configurations made via the Field Service System (FSS) and Pre-use check results including transducer calibrations will be erased. The lithium batteries must be replaced after 5 years.

PC 1772 Monitoring

Functional Main Blocks diagram marking: '**M**'

The main block Monitoring comprises microprocessor (**µP**) calculation of parameters and monitoring of alarm limits with control of alarms (as well as back-up alarm). The main block Monitoring cooperates with the Loudspeaker in the User Interface.

The PC 1772 Monitoring handles all supervision and alarms in the system. It activates pressure reducing mechanisms, including activation of the safety valve, in case of excessive breathing system pressure.

All alarms are conveyed and displayed on the front panel and the alarm sound is also generated. In case of malfunction in the loudspeaker located on PC 1777 Panel, a back-up sound generating device (buzzer) on PC 1772 will be activated automatically. This buzzer is monitored by a microphone at startup and during the Pre-use check.

The following voltages are supervised:

- +24 V
- +12 V
- -12 V
- +5 V
- +3.3 V.

The buzzer on PC 1772 Monitoring generates the alarm signal in case of +5 V or +3.3 V power failure. The buzzer and +5 V / +3.3 V failure logic is powered by back-up capacitors in case of power failure.

The alarm signal used by the optional 'Alarm output connection' is generated on PC 1772.

PC 1772 also contains a barometric transducer and the measured barometric pressure is supplied to the other sub-units in the system.

Trending of measured parameters are performed by Monitoring.

A thermistor on PC 1772 monitors the temperature inside the Patient Unit. An alarm is activated if the temperature is 77 ±5 °C (170 ±9 °F) or higher.

Includes an ID PROM. The ID information can be read by the Servo-i System.

Note: The System SW must be re-installed if PC 1772 is replaced.

A lithium battery on PC 1772 power supplies the internal memory on the PC board. If the battery on PC 1772 is disconnected or if the battery voltage is too low, all logs and Pre-use check results including transducer calibrations will be erased. The lithium batteries must be replaced after 5 years.

Power supply

Functional Main Blocks diagram marking: '**P**'

The main block Power Supply comprises conversion of mains power to internal power supply as well as the Module unit-connections for optional Battery modules and/or other optional modules.

The power modes in the Servo-i System are:

- At Power up, i. e. when the On/Off switch is turned On, all internal voltages will be enabled.
- At Power down, the Power supply system will deactivate the hardware signal Power_Good.H, and at the same time keep the internal voltages +5 V and +3.3 V for at least 1 ms, in order to let the different subsystems save their current settings in non-volatile memory. Power down can be caused by:
  - Turning the On/Off switch Off.
  - Mains failure and no back-up battery connected.
  - The system is powered from a battery, but the battery voltage is too low for proper operation of the system.

  In this Off mode, only charging of Battery modules is enabled (if the system is connected to mains). All other circuitry is un-powered.
- In Standby all circuitry is powered from the Power supply, but no breathing will be active. The operator can set all parameters, including breathing mode, during Standby.

Mains inlet

Inlet for mains power supply including grounding connection.

The Servo-i System will automatically adjust to the connected mains power if the mains power is within specified range. No voltage or frequence setting is required.

The mains inlet is equipped with two mains power fuses, F11 and F12, rated 2.5 A.

AC/DC Converter

Converts the connected AC Power (inlet voltage 85–250 V AC) to the internal DC supply voltage +12 V_Unreg.

PC 1778 DC/DC & Standard connectors

Converts the internal DC supply voltage +12 V_Unreg into the following internal DC supply voltages:

- +24 V
- +12 V
- -12 V
- +5 V
- +3.3 V

All standard connectors are located on this board. The connectors are the following:

- N26 – External +12 V DC supply input. The connectors is equipped with a fuse F1, rated 10 A.
- N27 – Optional equipment.
- N28 – Control cable.
- N29 – RS232.

Pin configuration and signal names can be found in chapter 'Diagrams'.

Includes an ID PROM. The ID information can be read by the Servo-i System.

PC 1775 Plug-and-play back-plane

Connects the Optional Modules that are inserted in the Module Unit.

PC 1775 also controls:

- Charging / discharging of the Battery modules.
- Switching between Mains / Battery / External 12 V power supply.
- Internal fan using input signals from the Temperator sensor in the O_2 cell connector.

Includes an ID PROM. The ID information can be read by the Servo-i System.

Module unit

Connection slots for 6 optional modules, e. g. Battery modules or CO_2 Analyzer module.

Internal fan

The Internal Fan forces cooling air through the Patient Unit. The cooling air flow inside the Patient Unit is indicated in the 'Functional Main Block Diagram'. The cooling air outlets are located in the expiratory section.

The Internal Fan is controlled by the Temperature Sensor in the O_2 cell connector via electronics on PC 1775 Plug-and-play back-plane.

The fan will start with half effect at approx. 33 °C (91 °F) and with full effect at approx. 43 °C (109 °F). When the temperature drops below approx. 37 °C (99 °F), the fan turns to half effect and when the temperature drops below approx. 27 °C (81 °F), the fan stops.

The air inlet is protected by a filter that must be cleaned or replaced during the 'Preventive maintenance'.

Optional PC board slots

Functional Main Blocks diagram marking: '**X**'

For optional equipment, the Servo-i is equipped with two extra PC-board slots.

The optional Alarm output connector (see below) is mounted in one of the extra PC-board slots.

Alarm output connector (optional)

Functional Main Blocks diagram marking: '**A**'

PC 1789 Remote alarm connector containing the optional function 'Alarm output connector' is mounted in the extra PC-board slot located below PC 1778 DC/DC & Standard connectors.

The Alarm output connector enables connection of an external alarm signal system to the Servo-i System. High and medium priority alarms are transferred, and the alarm output signal is active as long as the audio alarm is active on the ventilator.

The Alarm output connector has two contact functions: NO (Normally Open) and NC (Normally Closed). In an alarm situation the open contact will close and the closed one will open. The contacts are independent of polarity and can be used both with AC and DC systems.

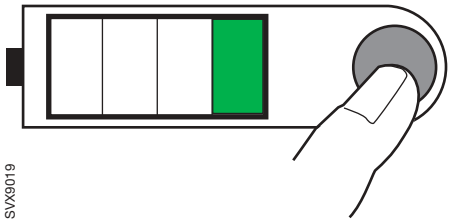
Pin configuration and signal names in P67 – Alarm output connector can be found in chapter 'Diagrams'.

The 'Alarm output'- function must be enabled in the configuration software.

For further information, refer to the 'Alarm output connector – Reference Manual'

Battery modules (optional)

The Battery module is rated 12 V, 3.5 Ah. Battery backup time is approx. 0.5 hour/battery. Up to six backup Battery modules can be connected to the Module unit.



Press the battery power symbol button to check the battery status. The lit sections of the battery power scale show remaining capacity.

- If no section is lit, the battery is fully discharged, e.g. due to long storage time, and requires up to 12 hours/battery charging time.
- If one section is lit or flashing, the battery requires approx. 3 hours/battery charging time.

The battery lifetime is limited and the batteries must thus be replaced after 3 years. Manufacturing date (year-week) is printed on the battery label.

Each battery includes an ID PROM. The ID information can be read by the Servo-i System.

CO_2 Analyzer module (optional)

The CO_2 Analyzer module is an optional accessory that is connected to the Module unit.

The CO_2 Analyzer option allows for continuous monitoring shown in a waveform (capnogram) and as numericals on the screen.

The CO_2 Analyzer module is, via a cable, connected to a Capnostat sensor mounted on an airway adapter at the Y-piece. The sensor uses a solid state and IR based optical system with no moveable parts. It measures the difference between a reference light beam and one filtered for CO_2 wavelength.

The 'CO_2 Analyzer'- function must be enabled in the configuration software.

Control cable

This Control Cable connects the Patient Unit and the User Interface. The cable can be partly winded up under a rubber cover on the rear of the User Interface.

Only personnel trained and authorized by Maquet shall be permitted to perform installation, service or maintenance of the Servo-i.

Make sure to prepare the Servo-i properly before disassembling and assembling. Refer to section 'Hazard notices' in chapter 'Important'.

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

4. Disassembling and assembling

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General

Disassembling of the main units in the Servo-i System is described in this chapter. If not stated otherwise, the assembling procedure is the reverse of the described disassembling procedure.

The illustrations in the Servo-i Spare Parts List are very useful as a guide when disassembling and assembling the Servo-i System.

Preparations

Before disassembling or assembling the Servo-i:

- Set the On / Off switch on the User Interface to **Off**.
- Disconnect the mains power cable.
- Disconnect the gas supplies (wall and/or tank).
- Disconnect Battery modules.
- Make sure that all gas conveying parts are cleaned according to instructions in the 'Servo-i Ventilator System – User's manual'.

After any service intervention in the Servo-i, perform a 'Pre-use check' according to instructions in the 'Servo-i Ventilator System – User's manual'.

Handling PC boards

The PC boards contain components that are highly sensitive to static electricity.

Those who come into contact with circuit boards containing sensitive components must take certain precautions to avoid damaging the components (ESD protection).

When working with ESD sensitive components, always use a grounded wrist band and grounded work surface. Adequate service tools must also be used.

PC boards (spare parts) must always be kept in protective packaging for sensitive electronic device.

PC boards must not be inserted or removed while the mains power or battery power is applied to the PC boards.

Remove and insert the PC boards very carefully to avoid damage to the connectors.

Replacing PC boards

The Servo-i software is distributed on different subsystems, located on the following PC boards:

- PC 1771 Control
- PC 1772 Monitoring
- PC 1784 Expiratory Channel
- PC 1777 Panel.

When delivered as spare parts, these PC boards are equipped with a 'System SW version' that may differ from the version on the unit to be repaired.
To keep the 'System SW version' used prior to the PC board replacement, a 'SW version update card' with the applicable 'System SW version' must be available for re-installation purposes.

For functionality enhancement, the latest released version of the System SW is always recommended.

Before installing a new 'System SW version' on a unit, ensure that the software is fully compatible with all HW-, SW- and mechanical components in the unit. If any compatibility conflicts are apparent this will be noted on the 'MAQUET Critical Care SW download' web site.

Assembling guidelines

The Servo-i system specifications allow unit operation also during patient transportation. All parts of the User Interface and the Patient Unit assembled with screws and nuts are therefore tightened with a specified torque and secured with threadlocking adhesives.

In order to maintain these specifications over time, it must be ensured that after any service intervention removed parts are re-assembled and secured according to instructions. Make sure to follow the guidelines stated below.

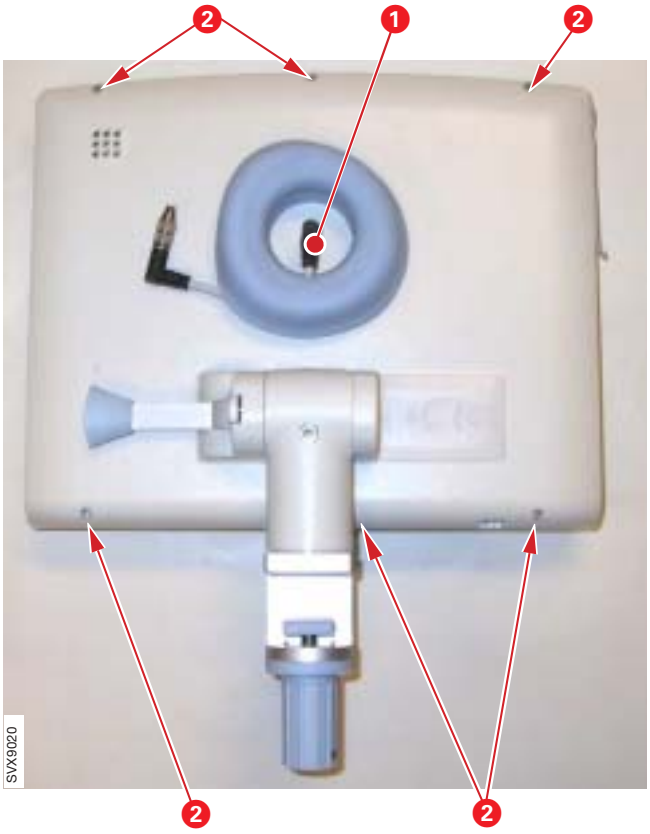
Tightening torque

- Thread size M3: 0.95 ±0.05 Nm
- Thread size M4–M6: 3.1 ±0.1 Nm.

Threadlocking adhesives

- Electrolube Bloc'Lube BLV15ML® on threads in contact with PC boards.
- Loctite 243® on all other threads.

Note: Threadlocking adhesive is not required on Heli-Coil® screw thread inserts as these screw thread-inserts have a self-locking function.



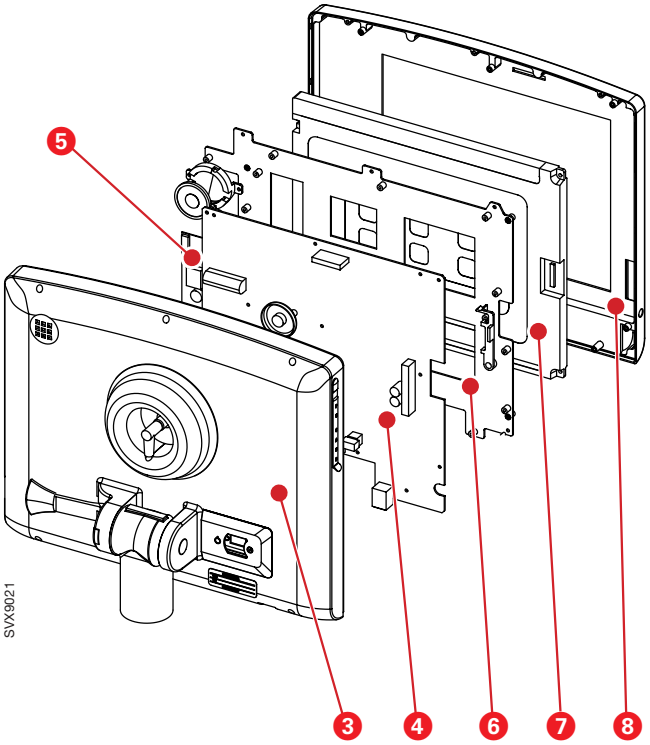
User Interface

To separate the front panel section from the rear cover:

- Disconnect the control cable (1).
- Remove the screws (2).
- Lift off the rear cover from the front panel section.

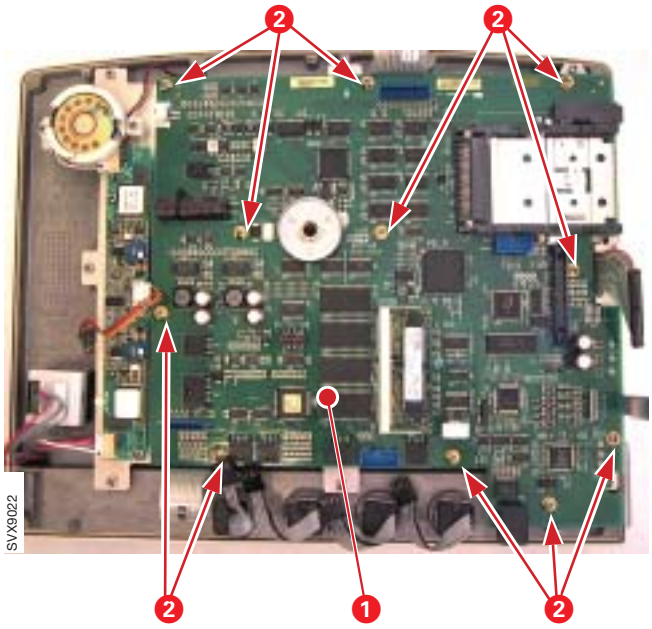
All parts inside the front panel section are now accessible.

> With power supply connected to the Servo-i, there are energized electrical components inside the unit, e. g. the backlight lamps that are supplied with 660 V by the Backlight Inverter. All personnel must exercise extreme caution if fault tracing or adjustments are performed with power supply connected and with the user interface rear cover removed.



The main parts of the User Interface are:

- Rear cover (3).
- PC 1777 Panel (4).
- Backlight Inverter (5).
- Support plate (6).
- TFT Display (7) including Backlight lamps.
- Touch screen assembly (8).



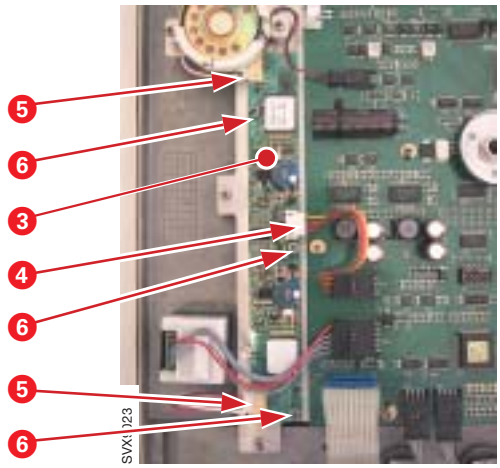
PC 1777 Panel

To remove PC 1777 Panel (1):

- Carefully disconnect all cable connectors from PC 1777.
- Remove the screws (2) holding PC 1777.
- Lift off PC 1777.

Note: When replacing PC 1777 Panel, it can be necessary to re-install the System SW. For further information, refer to section 'Replacing PC boards' in this chapter.

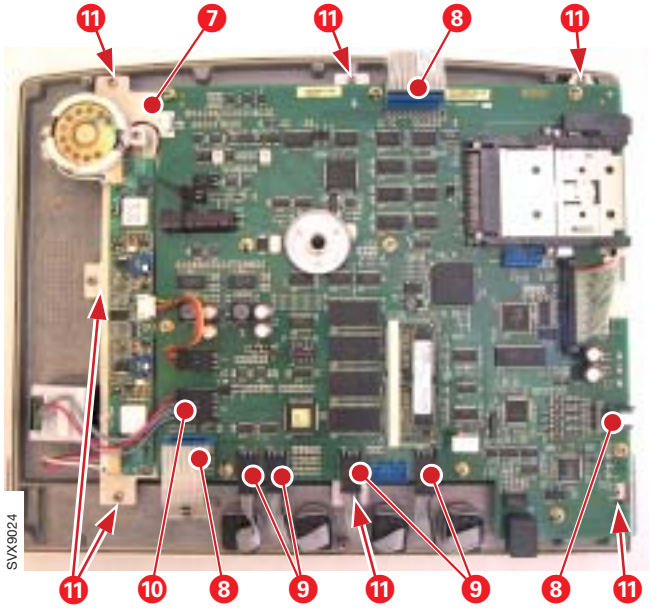
4



Backlight Inverter

To remove the PC board Backlight Inverter (3):

- Carefully disconnect the cable connector (4).
- Carefully disconnect the backlight lamp cable connectors (5).
- Remove the screws (6) holding PC board Backlight Inverter.
- Lift off PC board Backlight Inverter.

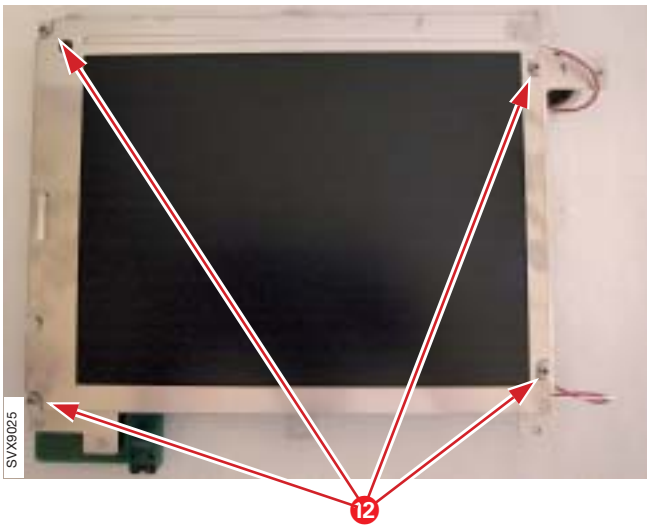


TFT Display

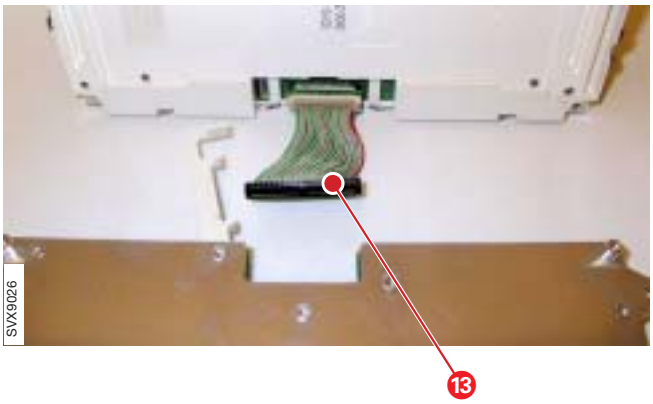
Note: Disassembling of the TFT Display must be performed in a clean and dustfree environment, as the TFT Display is sensitive to contaminants.

The TFT Display is mounted under the support plate (7). To remove the TFT Display:

- Disconnect the three touch-screen flat-cables (8).
- Disconnect the four Direct access control-cables (9).
- Disconnect the Main rotary dial-cable (10).
- Remove the screws (11) holding the support plate.
- Lift off the support plate-assembly, including TFT Display and PC boards.



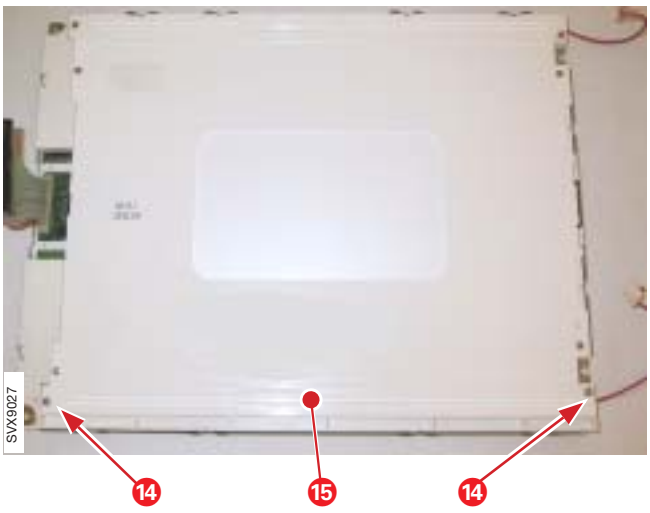
- Remove the screws (12) holding the TFT Display to the support plate.



- Carefully disconnect the cable (13) from PC 1777 as shown in the illustration and/or from the TFT Display connector.

4

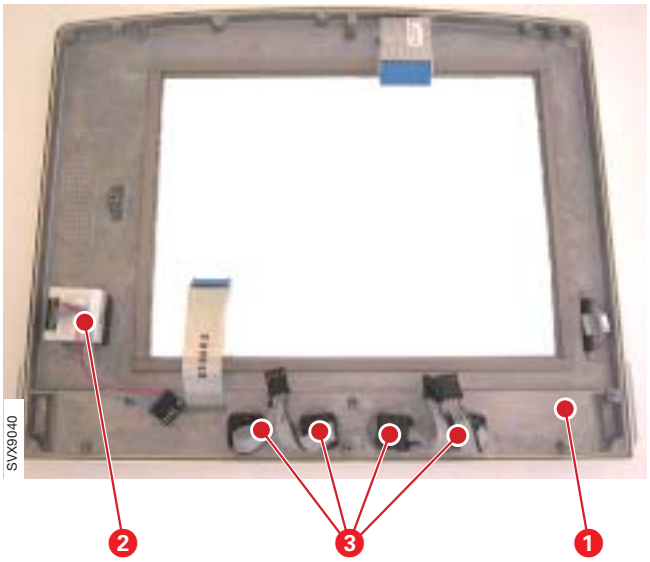
Backlight lamps



To access the Backlight lamps:

- Lift off the TFT Display. Refer to section 'TFT Display'.
- Remove the screws (14) holding the lamp. On older units, the lamps are mounted with a snap-in holder.
- Lift off the lamp (15).

Note: The Backlight lamp kit includes two lamps. Always replace both lamps at the same time. Using the Field Service System (FSS), a time meter for the lamps can be shown. This time meter must be reset after replacement of the lamps.

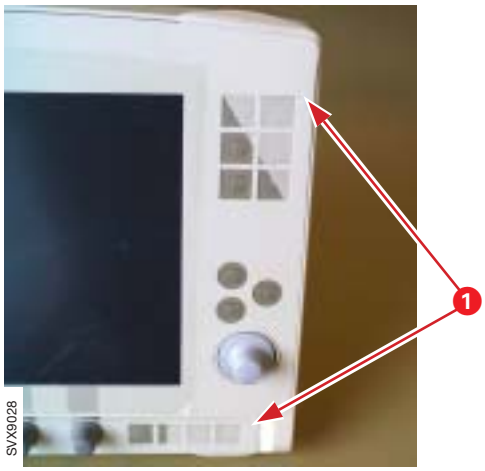


Touch screen assembly

To remove the Touch screen assembly (1):

- Lift off the TFT Display. Refer to section 'TFT Display'.
- Remove the Main rotary dial (2):
  - Pull off the Main rotary dial-knob.
  - Remove the nut holding the Main rotary dial.
  - Lift off the Main rotary dial.
- Remove the Direct access controls (3):
  - Remove the cover on each Direct access control-knob.
  - Loosen the nut on each knob and pull off the knobs.
  - Remove the nut holding each Direct access control and lift off the controls.

Note: When mounting the Main rotary dial and the Direct access controls on a new Touch screen assembly, make sure that the knobs are easy to turn.



Label strips

The touch screen assembly is delivered with label strips in different languages, which have to be mounted before the unit is taken into operation. Protective foils (1) separate the adhesive areas between the front panel film and the front panel.

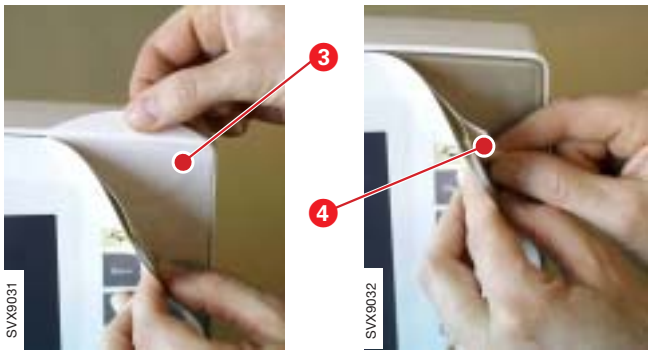
Mount the label strips as follows:

- Select the two appropriate label strips:
  - One label strip for the Fixed keys on the upper right-hand area, and
  - One label strip for the Special functions keys on the lower right-hand area of the User Interface.
- Discard all other label strips.

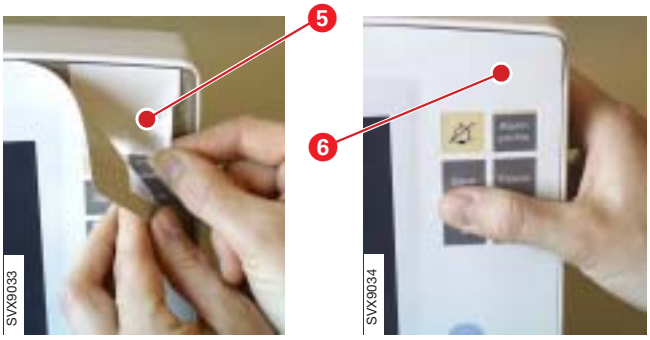
Fixed keys label

- Insert the fixed keys label strip (2).
- Check its position through the button windows of the front panel film. Adjust if necessary.

> Align the label strip with great care. Once installed the process cannot be reversed.



- While holding the label strip in correct position, remove the protective foils (3 and 4).
- Press the label strip against the adhesive area.



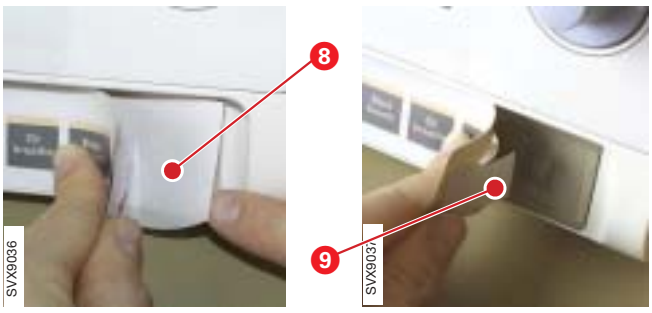
- Remove the protective foil (5).
- Press the front panel film (6) firmly against the front panel to ensure proper adhesion.

4

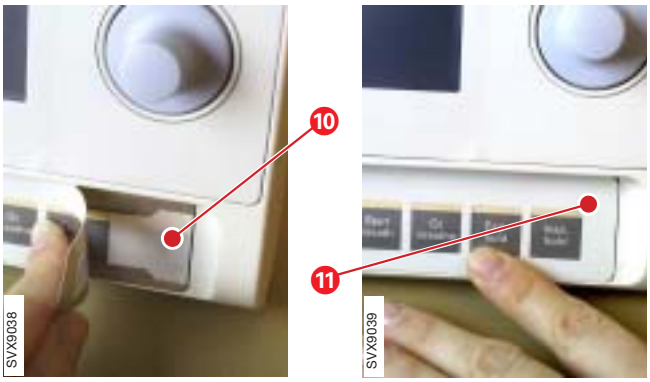
Special functions keys label

- Insert the Special functions keys label strip (7).
- Check its position through the button windows of the front panel film. Adjust if necessary.

> Align the label strip with great care. Once installed the process cannot be reversed.



- While holding the label strip in correct position, remove the protective foils (8 and 9).



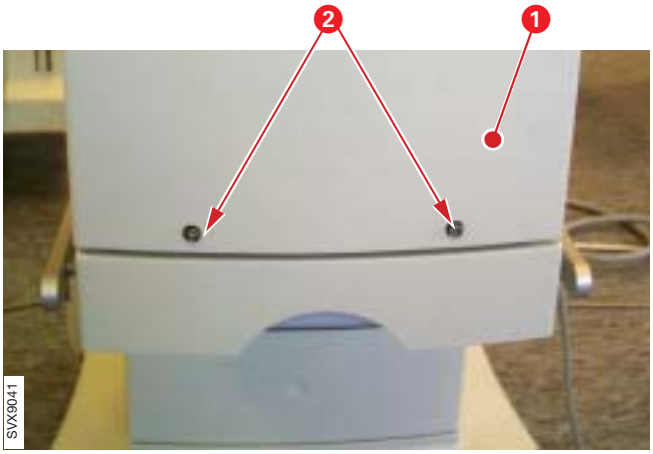
- Press the label strip against the adhesive area.
- Remove the protective foil (10).
- Press the front panel film (11) firmly against the front panel to ensure proper adhesion.

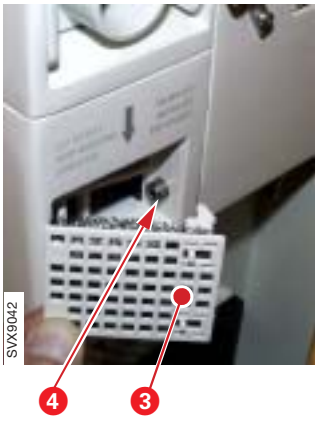
Patient Unit

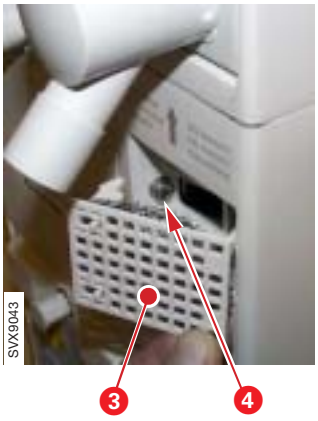
Front cover

To remove the Patient Unit front cover (1):

- Remove the screw covers and the screws (2).





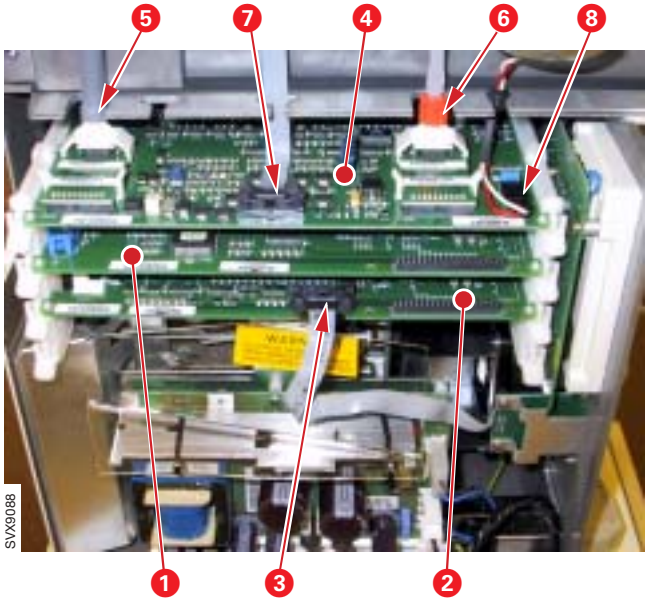


- Remove the two ventilation covers (3).
- Remove the two screws (4).

- Carefully lift off the Patient Unit front cover (1).

Note: When assembling the unit, make sure that the inspiratory and expiratory pressure transducer tubes and the PC 1785 and expiratory valve coil cables are not damaged by the Patient Unit front cover (1).

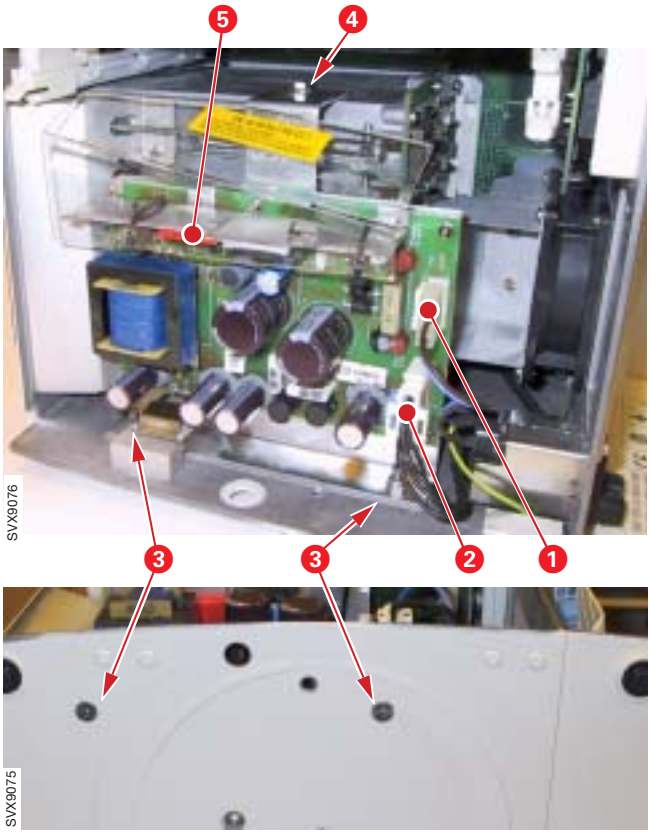
With power supply connected to the Servo-i, there are energized electrical components inside the unit. All personnel must exercise extreme caution if fault tracing or adjustments are performed with power supply connected and with the Patient Unit front cover removed.



PC 1771, PC 1772 and PC 1784

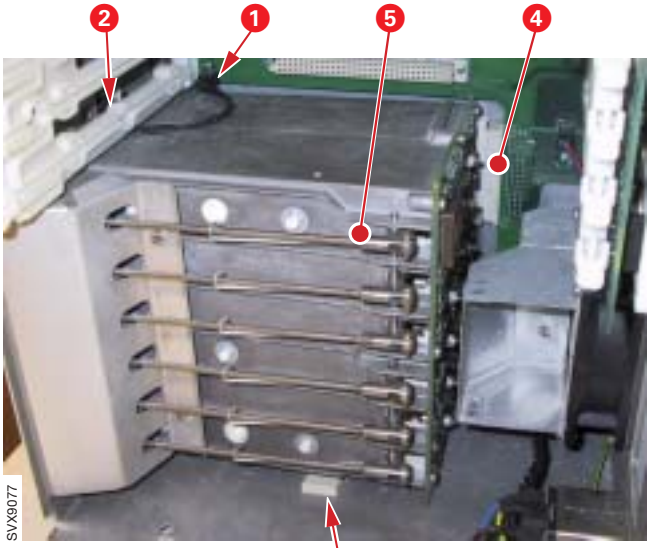
- Remove the Patient Unit front cover.
- PC 1771 Control (1):
  - Release the locks on the PC board guides.
  - Carefully pull out the PC board.
- PC 1772 Monitoring (2):
  - Disconnect PC 1789 cable connector (3). This is the cable for the optional PC 1789 Remote alarm connector.
  - Release the locks on the PC board guides.
  - Carefully pull out the PC board.
- PC 1784 Expiratory channel (4):
  - Disconnect pressure transducer tubes (5 and 6)
  - Disconnect PC 1785 cable connector (7)
  - Disconnect Exp. valve coil cable connector (8).
  - Release the locks on the PC board guides.
  - Carefully pull out the PC board.

Note: When replacing PC 1771 Control, PC 1772 Monitoring or PC 1784 Expiratory Channel, it can be necessary to re-install the System SW. For further information refer to section 'Replacing PC boards' in this chapter.



AC/DC Converter

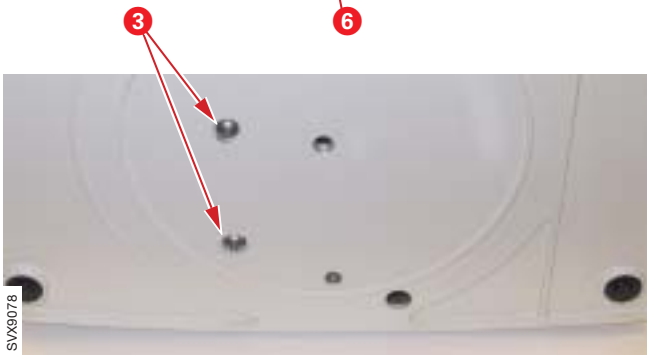
- Remove the Patient Unit front cover.
- Disconnect cable connectors (1 and 2).
- Remove the screws and nuts (3).
- Remove the screw (4).
- Carefully lift out the AC/DC Converter (5).

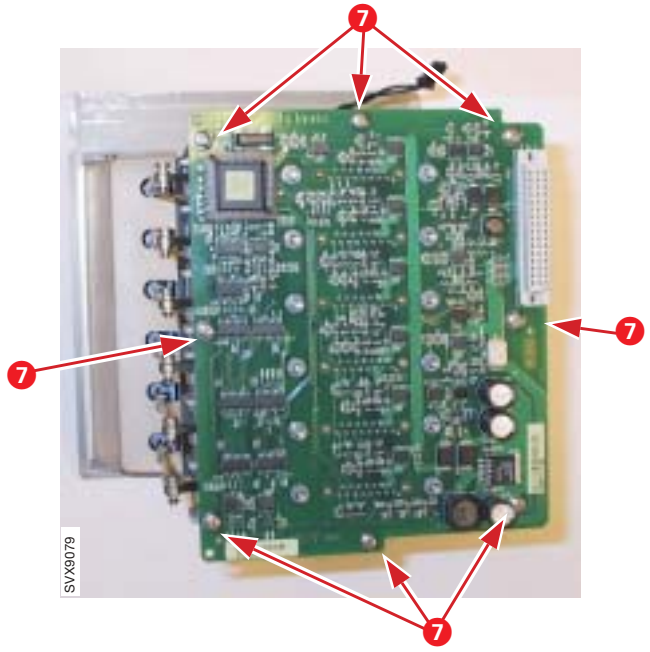


Module unit including PC 1775 Plug-and-play back-plane

- Remove the Patient Unit front cover.
- Remove the AC/DC Converter.
- Disconnect the nebulizer cable connector (1).
- Remove the screw (2).
- Remove the screws (3).
- Disconnect the Module unit/PC 1775 from PC 1770 Main back-plane at the connector (4).
- Carefully lift out the Module unit (5).

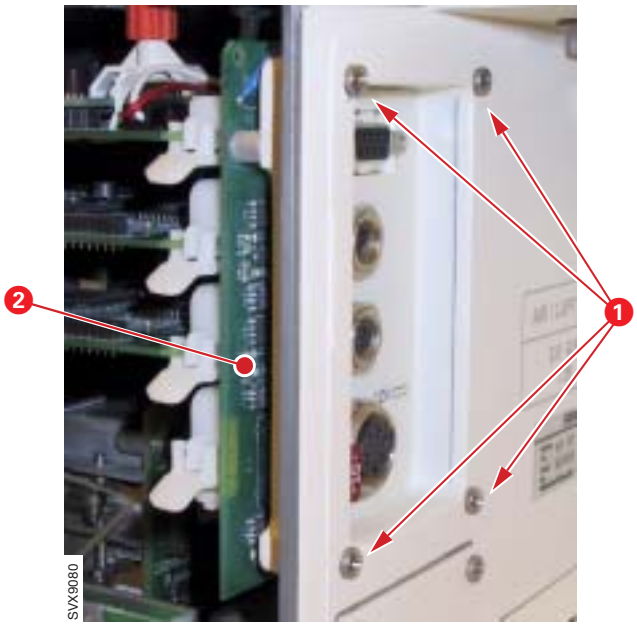
Note: When assembling the unit, make sure that the spacer (6) is in position with its flat side facing down. The spacer, designed as a wedge, should be pushed inwards before the screws (3) are tightened.





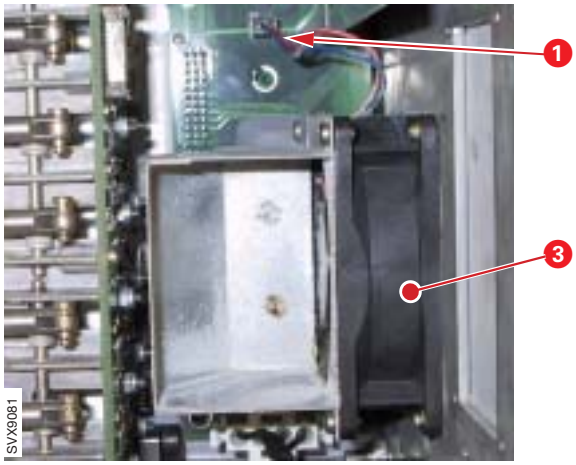
PC 1775 Plug-and-play back-plane is mounted on the Module unit with the screws (7).

PC 1778 DC/DC & Standard connectors



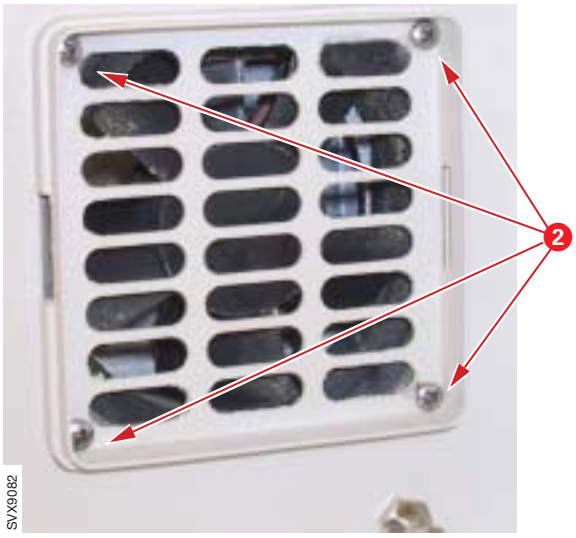
- Remove the Patient Unit front cover.
- Remove the screws (1).
- Carefully pull out PC 1778 (2).

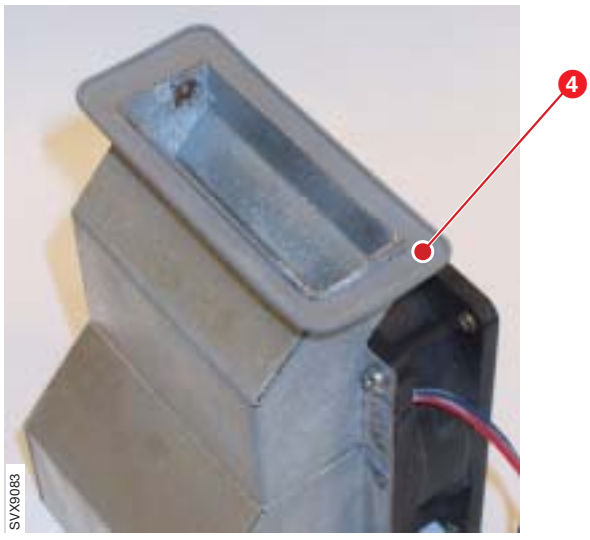
Internal fan

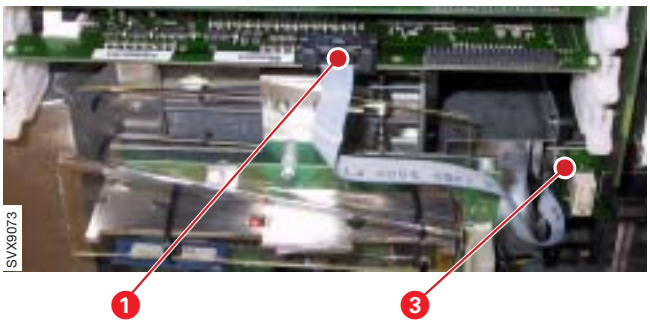


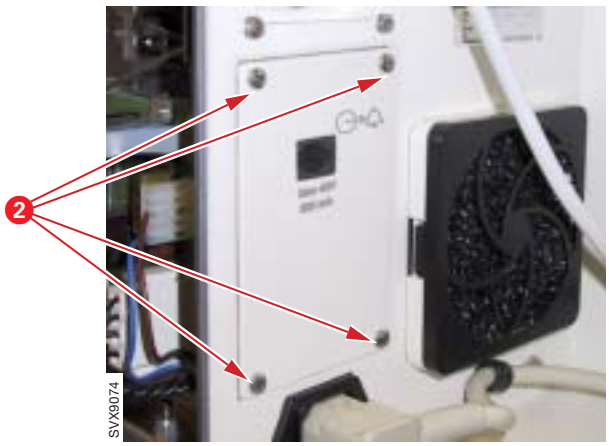
- Remove the AC/DC Converter.
- Remove PC 1789 Remote alarm connector if mounted.
- Disconnect the fan cable connector (1).
- Remove the screws (2).
- Carefully lift out the Internal fan (3).

Note: When assembling, make sure that the rubber seal (4) is mounted as shown in the illustration.





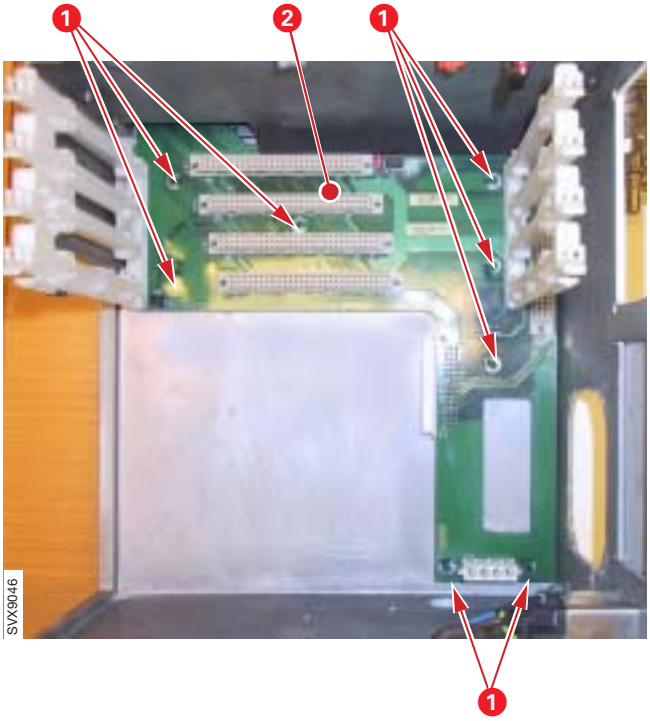




PC 1789 Remote alarm connector

PC 1789 Remote alarm connector is part of the optional Alarm output connector.

- Disconnect the cable (1).
- Remove the screws (2).
- Carefully lift out PC 1789 (3).



PC 1770 Main back-plane

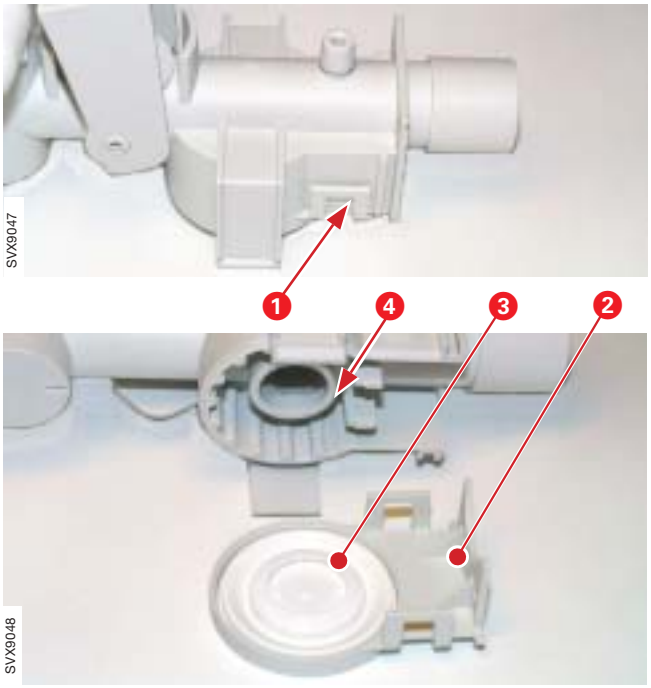
- Remove PC 1780 Pneumatic back-plane (inside the Inspiratory section).
- Remove:
  - PC 1772 Monitoring
  - PC 1771 Control
  - PC 1784 Expiratory channel.
- Remove the AC/DC Converter.
- Remove the Module unit.
- Remove PC 1778 DC/DC & Standard connectors.
- Remove PC 1789 Remote alarm connector if mounted.
- Remove the Internal fan.
- Remove the screws (1).
- Carefully lift out PC 1770 (2).

Note: The ventilators System ID, configuration, time stamp for preventive maintenance, etc, is stored in an EEPROM on PC 1770 Main back-plane (2). Thus, when replacing PC 1770, a spare part that is factory programmed for the concerned ventilator must be used. For further information refer to chapter 'Description of functions'.

Inspiratory channel

Removal of the inspiratory channel, as well as replacement of O_2 cell/filter, is described in the User's manual, chapter 'Maintenance'.

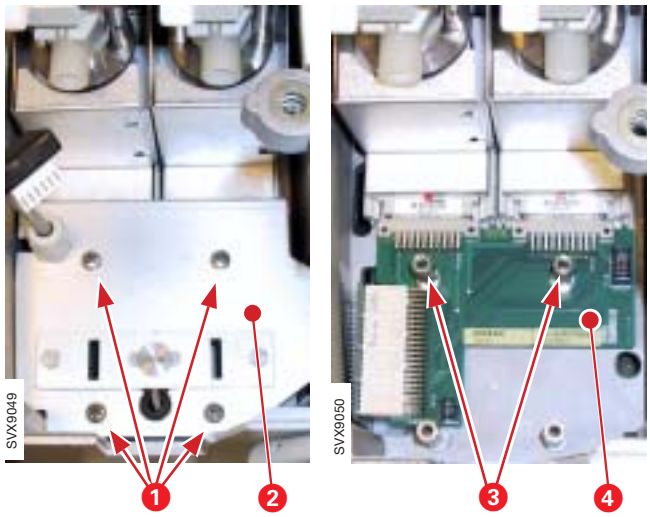
Safety valve membrane



To remove the safety valve membrane:

- Remove the inspiratory channel.
- Release the latches (1), one on each side of the safety valve housing, and lift off the membrane holder (2).
- The membrane (3) and the valve seat (4) are now accessible, e.g. for inspection and cleaning.

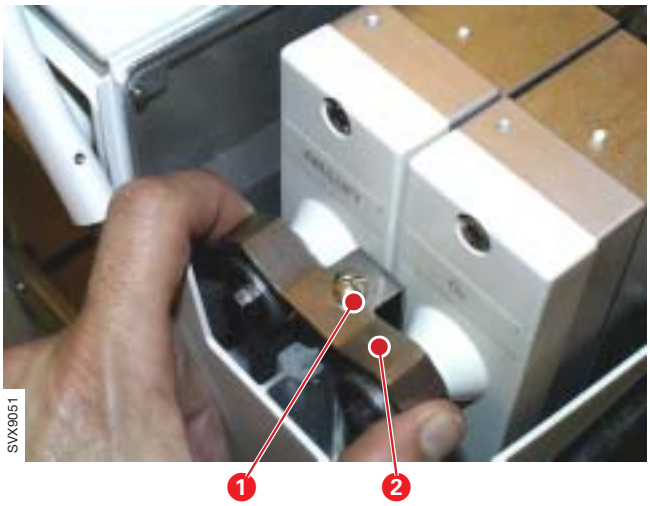
PC 1780 Pneumatic back-plane



To remove PC 1780:

- Remove the inspiratory channel including filter for the inspiratory pressure transducer.
- Remove the screws (1).
- Carefully lift the mounting plate (2) and disconnect the O_2 cell connector and the safety valve pull magnet connector from PC 1780.
- Lift off the mounting plate (2). The safety valve pull magnet is mounted on this plate.
- Pull out the gas modules to disconnect them from PC 1780.
- Remove the threaded studs (3).
- Disconnect and lift off PC 1780 (4).

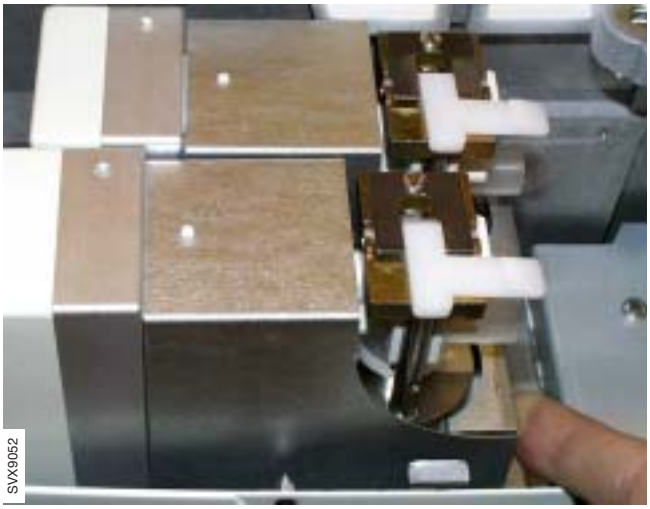
Note: When assembling, the mounting plate (2) must be adjusted to correspond with the inspiratory channel latches.



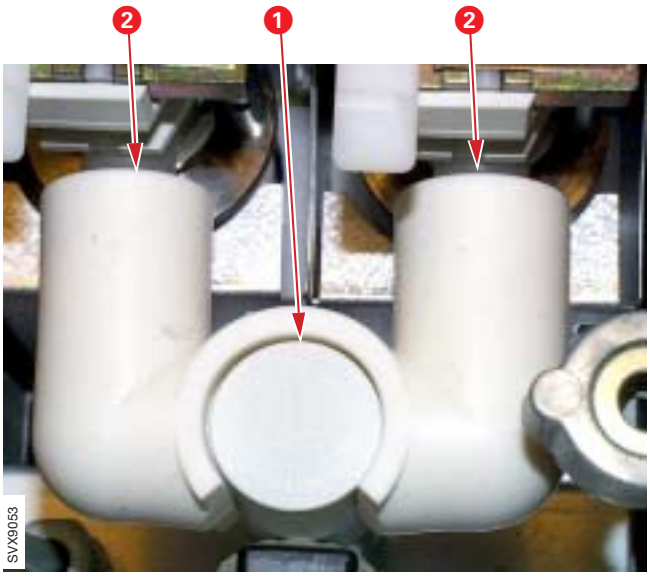
Gas modules

To remove the gas modules:

- Remove the inspiratory section cover.
- Loosen the screw (1).
- Lift off the gas module bracket (2).

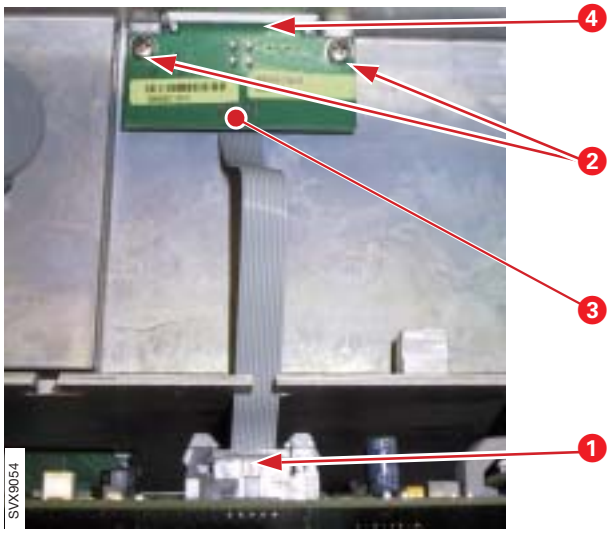


- Pull out and lift off both gas modules.



Note 1: When assembling, make sure that the connector muff properly seals around the inspiratory pipe (1). The connector muff must not be pushed too far onto the nozzle units (2).

Note 2: The gas modules used in Servo-i are factory adjusted for this purpose. When replacing gas modules, make sure to use only Servo-i gas modules. Similar gas modules intended for the SV 300/300A or KION / KION-i Systems must not be used.

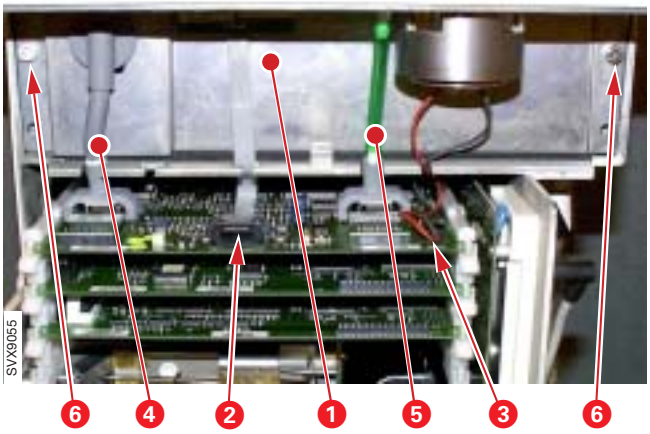


PC 1785 Expiratory channel connector

To remove PC 1785:

- Remove the Patient Unit front cover.
- Disconnect the PC 1785 cable connector (1).
- Remove the screws (2).
- Pull down and lift off PC 1785 (3).

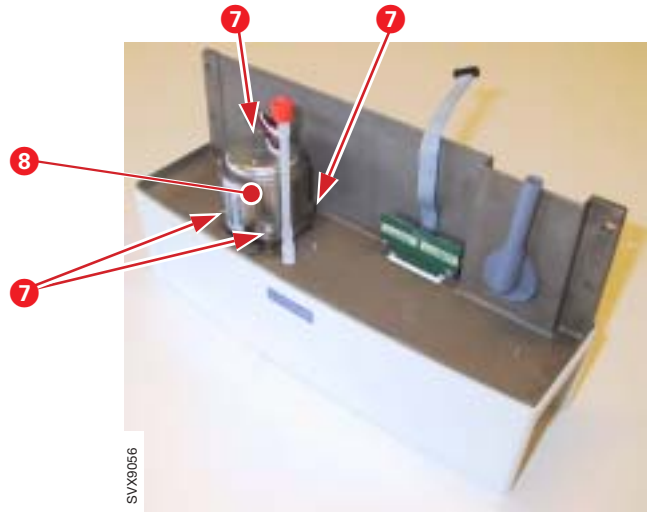
Note: When assembling, make sure that the rubber seal (4) is correctly seated around PC 1785.



Expiratory valve coil

To remove the expiratory valve coil:

- Remove the Patient Unit front cover.
- Disconnect the connectors (2 and 3) from PC 1784.
- Disconnect the tubes (4 and 5) from PC 1784.
- Disconnect the inspiratory pressure tube from the inspiratory pipe inside the inspiratory section (not visible in this illustration).
- Remove the two screws (6).
- Lift off the cassette compartment (1).



- Remove the screws (7).
- Lift off the expiratory valve coil (8).

Expiratory cassette membrane

The expiratory cassette is a complete unit and must not be disassembled. The only part that can be replaced is the valve membrane.

Operating capacity for the membrane is estimated to 10.000.000 breathing cycles. When this limit is passed or if the membrane for some reason has become defective, it must be replaced.

Remaining operating capacity (in %) for the membrane can be shown in the Status window. Select Status / Exp. cassette to check 'Remaining membrane capacity'. The operating capacity meter must be reset after replacement of the membrane.

It is very important for the function of the expiratory valve that the valve membrane is removed and mounted correctly as described below.

To remove the valve membrane from the cassette:

- Carefully remove the membrane including retaining ring using a suitable retaining ring pliers.

To mount the valve membrane into the cassette:

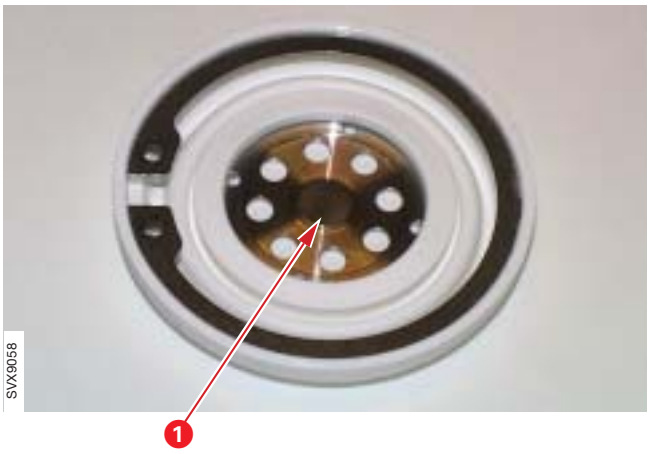
- Place the retaining ring (1) correctly into the membrane.

It is very important that the valve membrane and the membrane seat in the cassette is clean. Dirt particles can create leakage in the cassette.

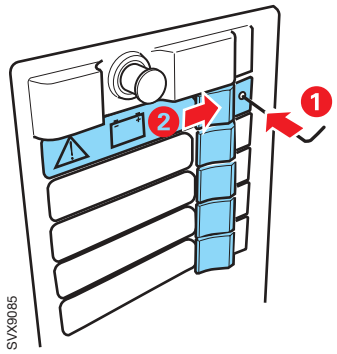
- Place the membrane onto the cassette as shown in the illustration.

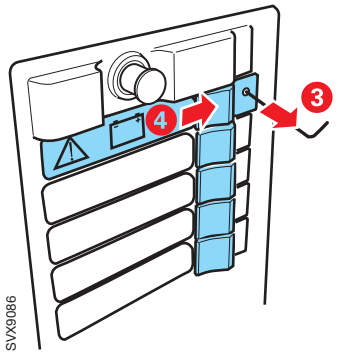
- Squeeze the retaining ring pliers and carefully press the membrane in place into the cassette as shown in the illustration.

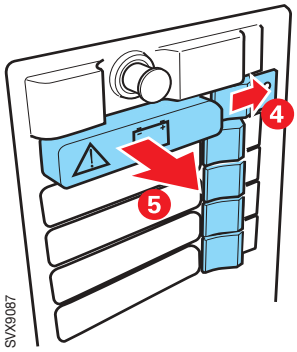
- Carefully release and remove the retaining ring pliers.
- Check that the membrane is not deformed by the retaining ring. If necessary, remove the membrane and redo the complete mounting procedure.
- Mount the expiratory cassette onto the Patient Unit.
- Reset the operating capacity meter after replacement of the membrane. To access the reset button, select Menu / Biomed / Service.



Note: If the metal washer has been separated from the membrane, it is important that the washer is correctly mounted. The washers raised hub (1) must be facing outwards as shown in the adjacent illustration.



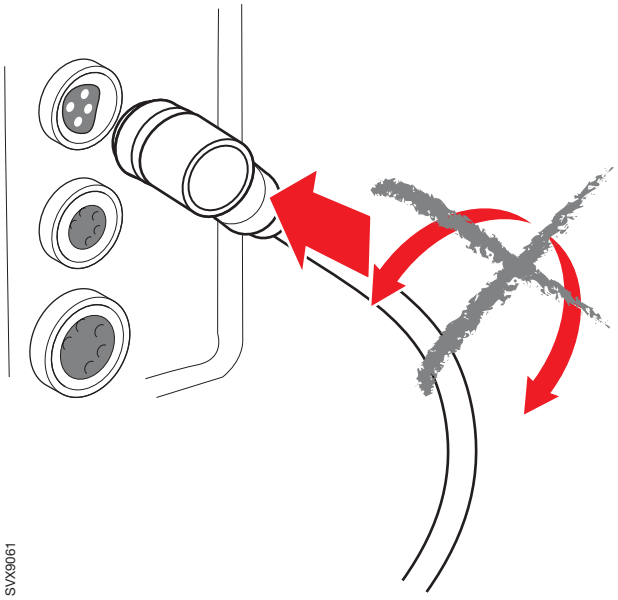




Fixed battery module

If the upper slot in the Module unit is equipped with a latch, a tool and two-hand operation is required to remove the Battery module. To release the fixed battery module:

1. Push a suitable tool, e.g. a small hexagonal wrench or a screwdriver, through the hole as shown in the illustration.
2. At the same time, push the release button to the right.
3. Remove the tool.
4. Continue to push the release button until the Battery module snaps out.
5. Pull out the Battery module.



Control cable

The control cable connectors must be connected carefully to avoid damages on the connector pins.

- Carefully find the correct position; the connector pins and the guides in the connectors must correspond. Do not turn the connector while inserting!
- When correct position is found, insert the connector.
- Secure the connector with its locking ring.

The illustration shows the Patient Unit connector, but the procedure for the User Interface connector is the same.

Only personnel trained and authorized by Maquet shall be permitted to perform installation, service or maintenance of the Servo-i.

Make sure to prepare the Servo-i properly before disassembling and assembling. Refer to section 'Hazard notices' in chapter 'Important'.

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

5. Service procedures

Checking the Battery modules ..... 5 - 2

Replacing the lithium batteries on PC 1771 and PC 1772 ..... 5 - 3

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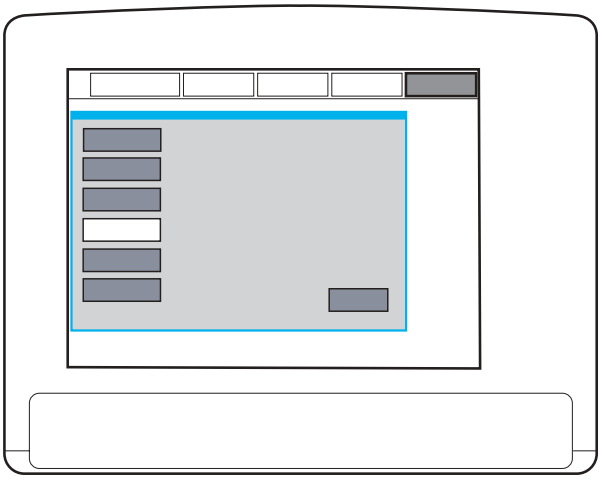
- General ..... 5 - 6
- Field Service System functions ..... 5 - 6

Checking the Battery modules

Check the manufacturing date of the Battery module. Manufacturing date (year-week) is printed on the battery label.

The batteries must be replaced after 3 years.

SVX9062


SVX9063

- Allow the Battery modules to charge until it is fully charged. To display battery status:
  - Press the battery power symbol button on the battery. All four LEDs must be lit.

    or

  - Select Status / General on the User Interface. Check that Battery backup time is more than 30 minutes on the concerned battery.

- With gas, patient tubes and test lung connected, let the Servo-i run in a ventilation mode.
- Disconnect mains power to the unit to allow battery operation.
- Let the Servo-i run in battery operation and check that the '**No battery capacity**'-alarm is not activated within the specified time. The operating time is dependent on the number of Battery modules connected, refer to the 'Servo-i Ventilator System – User's manual'.
- Check that the time between the '**Limited battery capacity**'- alarm and the '**No battery capacity**'-alarm is more than 7 minutes.

  Note: All alarms are time-stamped and stored. They can be displayed in the Event log.

Allow the backup battery to recharge before clinical use of the Servo-i. For Charging time, refer to the 'Servo-i Ventilator System – User's manual'.

After any maintenance or service of the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's manual'.

Replacing the lithium batteries on PC 1771 and PC 1772

The lithium batteries must be replaced after 5 years. A Technical error message will appear on the screen if the battery voltage level is too low.

Always replace booth batteries at the same time to keep the same replacement date for both batteries.

Preparations

- Set the On/Off switch on the control unit to **Off**.
- Disconnect the mains power cable.
- Disconnect the gas supplies (wall and/or cylinder).
- Remove patient tubing.

Replacing the lithium battery

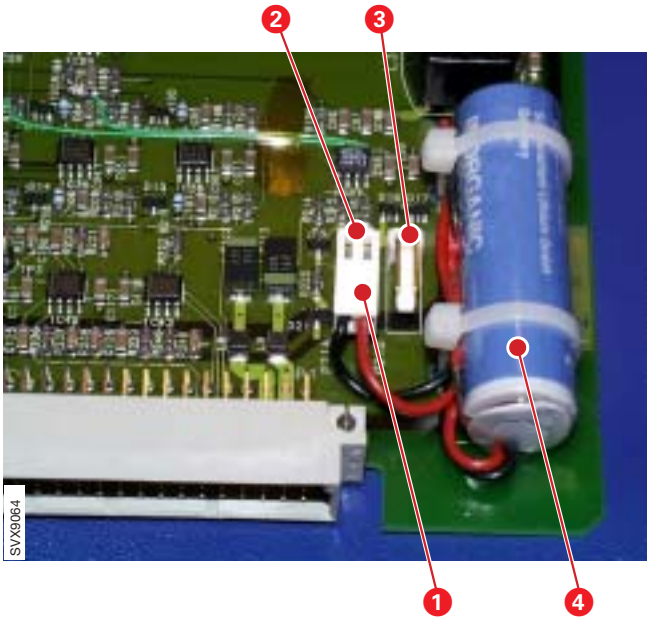
- The lithium batteries are mounted on ESD sensitive PC boards. Refer to chapter 'Disassembling and assembling', section 'Handling PC boards' for further information regarding ESD sensitive components.
- Remove the Patient Unit front cover. Refer to chapter 'Disassembling and assembling'.
- Carefully pull out PC 1771 and PC 1772.

  Note: Do not remove the cable connector (1). Information stored in the PC board memory will be erased if the connector is removed:

  – If the battery on PC 1771 is disconnected; user default configurations made via the Field Service System (FSS) and Pre-use check results including transducer calibrations will be erased.

  – If the battery on PC 1772 is disconnected; all trends, all logs and Pre-use check results including transducer calibrations will be erased.
- There are two equal battery connectors (2 and 3) on the PC boards. Connect the new battery to the un-used connector. The memory functions are now secured by the new battery.
- Cut the cable ties holding the old battery (4) to the PC board.
- Disconnect and remove the old battery.
- Mount the new battery onto the PC board using new cable ties as shown in the illustration.
- Insert the PC board into the correct PC-board slot and reassemble the Patient Unit.

After any maintenance or service of the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's manual'.



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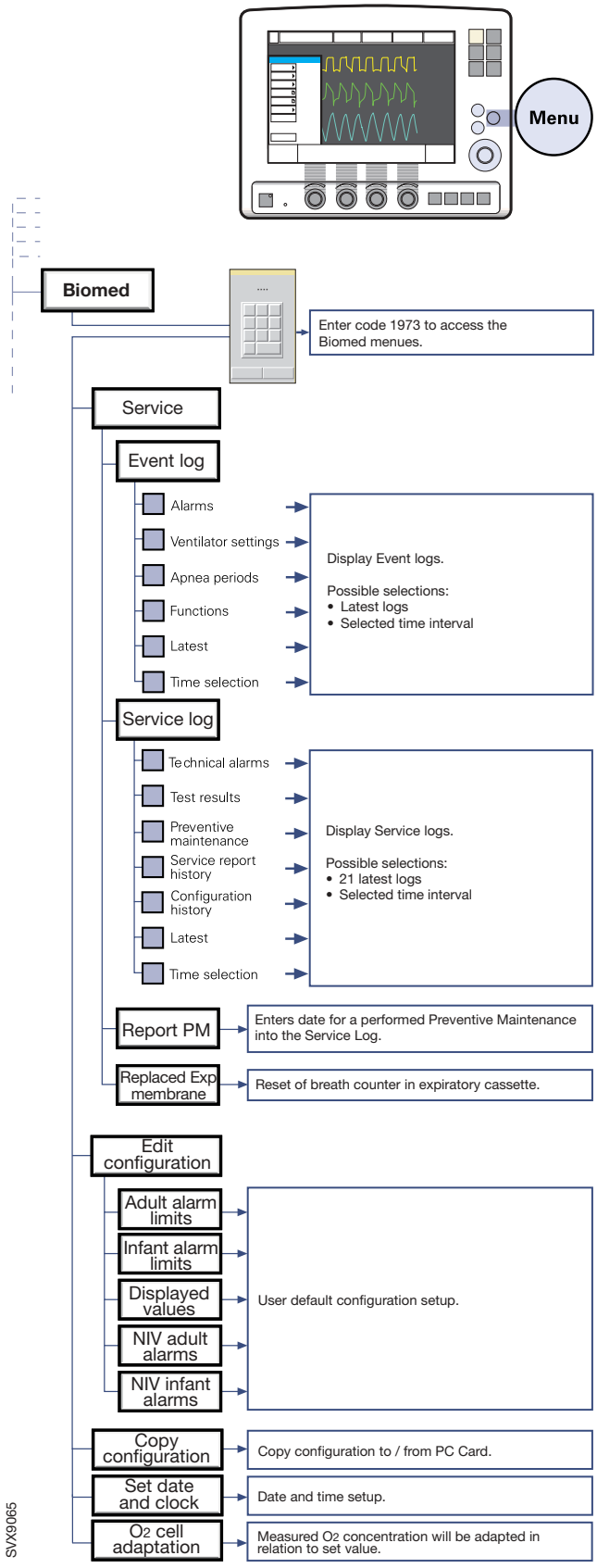

Using the Menu and Biomed key

The 'Menu' and 'Biomed' functions are useful tools during service.

The adjacent flowchart shows the 'Biomed' functions in System version 2.0. A complete set of flowcharts showing all 'Keys' and 'Screen touch pad' functions can be found in the 'Servo-i Ventilator System – User's Manual', appendix 'User Interface'.

Menu

Pressing the fixed key 'Menu' will open the 'Menu window' on the User Interface.

The 'Menu' is active in Standby and during ventilation mode, but the available submenus differs.

Possible selections in the 'Menu' window are:

- Alarm
- Review
- Options
- Complience compensation
- Copy
- Biomed
- Panel lock
- Change patient category (only during ventilation).

Biomed

The 'Biomed' submenu is intended only for Service Personnel and the code **1973** is required to access the 'Biomed' submenus.

The 'Biomed' menu is active in Standby and during ventilation mode, but the available submenus differs.

Service

Available only in Standby mode.

Event Log:

Displays Event logs. Useful during troubleshooting.

Service Log:

Displays Service logs. Useful during troubleshooting.

Report PM:

This button must be pressed when a Preventive Maintenance has been performed. This will reset the timer that indicates operating hours until next Preventive Maintenance.

Replaced Exp membrane:

This button must be pressed when the Expiratory cassette membrane has been replaced. This will reset the operating capacity meter (breath counter) in the expiratory cassette.

Edit configuration

Available only in Standby mode.

Default Alarm limits can be changed in this window:

Adult alarm limits and Infant alarm limits

- Pressure – Upper alarm limit
- Minute Volume – Lower and Upper alarm limit
- Respiratory Rate – Lower and Upper alarm limit
- End Exp. Pressure – Lower alarm limit
- End Tidal CO_2 – Lower and Upper alarm limit
- Apnea time – Upper alarm limit.

Default configuration regarding 'General' and 'Units' cannot be changed in this window. Access to the Field Service System (FSS) is required.

Displayed values

The Measured value boxes on the User Interface shows different parameters. Some of these parameters are fixed and some are selectable in this window.

NIV adult alarms and NIV infant alarms

- Pressure – Upper alarm limit
- Minute Volume – Lower and Upper alarm limit
- Respiratory Rate – Lower and Upper alarm limit
- End Exp. Pressure – Lower alarm limit
- End Tidal CO_2 – Lower and Upper alarm limit

The alarms listed above, except Pressure alarm, can be permanently silenced in this window.

Default configuration regarding 'General' and 'Units' cannot be changed in this window. Access to the Field Service System (FSS) is required.

Copy configuration

Available only in Standby mode.

Default user configuration can be copied to / from a PC Card.

Default configuration regarding 'General', 'Units' and 'Alarm limits' will be copied.

Useful when applying the same user configuration on a number of units.

Set date and clock

Available only in Standby mode.

Date and time setting can be changed in this window.

O_2 cell adaptation

Available only during ventilation.

Adjustment of the O_2 concentration reading.

Refer to the 'Servo-i Ventilator System – User's Manual', chapter Operating your Servo-i / Operating - Adjustments for further information.

Software installation

General

- Before starting any software upgrade or update, check the version of the:
  - Installed System SW ("see 'System SW version' in the General / Status window)
  - System SW stored on the PC Card.

  It is not recommended to install System SW with lower version number than already installed in the Servo Ventilator System.
- After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check' according to instructions in the 'Servo-i Ventilator System – User's manual'.

Software information

There are two different intentions for software installation:

System SW Update

A 'System SW Update' will install a new System SW version in the Servo-i Ventilator System. System SW Updates are not dependent on the serial number of the ventilator and will not alter the installed options.

Option Upgrade

An 'Option Upgrade' will change the function of the Servo-i Ventilator System. An Option Upgrade is individually created for each ventilator and can only be installed on this ventilator. Serial number of the ventilator must be stated when ordering an Option Upgrade.

Software installation procedure

Further information regarding the different softwares and the software installation procedure can be found in the Installation Instructions enclosed with the PC Cards. The Installation Instructions is also available on the 'MAQUET Critical Care SW download' web site.

Field Service System

General

- The Field Service System (FSS) is a software provided to facilitate troubleshooting, service and maintenance of the Servo-i Ventilator System.
- To access the Field Service System, a Service card (PC Card) and an access code must be used. The access code is unique for each Service card.
- The Service card is personal and must not be handed-over to anyone else.
- It is only possible to access the Field Service System with the Servo-i in Standby mode.
- The Field Service System must not be activated with a patient connected the Servo-i.

Field Service System functions

In the Field Service System, it is possible to:

- Display information regarding the ventilator including options and parts installed.
- Calibrate the internal barometer.
- Display service and event logs.
- Run complete or selected test sequences.
- Create and save service reports.
- Export selected logs to a PC Card.
- Create user default configurations.

Only personnel trained and authorized by Maquet shall be permitted to perform installation, service or maintenance of the Servo-i.

Make sure to prepare the Servo-i properly before disassembling and assembling. Refer to section 'Hazard notices' in chapter 'Important'.

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

6. Troubleshooting

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Pre-use check ..... 6 - 3
Technical error codes ..... 6 - 11

6

Possible causes to malfunction not mentioned in the following troubleshooting guides are:

- The system has not been correctly assembled after cleaning, maintenance or service.
- Disconnection or bad connection in cable connectors, PC board connectors, and interconnection boards.
- Disconnected or defective gas tubes.

These possible causes to malfunction must always be concidered during troubleshooting.

General

Before starting troubleshooting, try to eliminate all possibilities of operational errors. If the malfunction remains, use the troubleshooting guides below as well as the information in chapter 'Description of functions' to locate the faulty part. Perform actions step by step and check that the malfunction is eliminated.

When the fault is corrected, carry out a complete 'Pre-use check' as described in the 'Servo-i Ventilator System – User's manual'.

The troubleshooting guides below are focused only on technical problems. Information about clinical related problems can be found in the 'Servo-i Ventilator System – User's manual'.

For functionality enhancement, the latest released version of the System SW is always recommended.

Pre-use check

The Servo-i demands the user to start the automatic Pre-use check at every start-up of the unit. It is also possible to select the Pre-use check via the Standby menu.

The 'Servo-i Ventilator System – User's Manual' describes how to perform this Pre-use check. The Pre-use check-description on the following pages gives more detailed information about the Pre-use check. This information can be used e.g. during troubleshooting of the unit.

Some of the recommended actions described below refer to the Field Service System (FSS). The Service card is required to access the FSS. Troubleshooting can of course be performed without access to the FSS, but for some of the recommended actions, the FSS will make troubleshooting faster and easier.

Check if the fault remains after each performed service action. Re-run the complete Pre-use check or run the concerned test using the FSS.

***** Text within brackets refers to the tested subsystem; BRE = Breathing, MON = Monitor, PAN = Panel.

Test	Test description *	Recommended action if the test fails
During system start-up.	Internal technical tests: • SW check • Reading EEPROM • Checksum EEPROM • Panel button stuck test • Audio test. (BRE + MON + PAN)	1. Restart the unit. Do not touch the User Interface during system start-up. Interfering with the knobs, keys, touch screen, loudspeaker grid, etc, may affect the internal technical tests. 2. Reinstall the System SW.

Start Pre-use check

Internal tests	Audio test. (MON + PAN) Alarm output connector test. Performed only if this option is installed. (MON) Power failure test. (MON)	If possible, check the 'Test results'-log in the 'More detailed' mode (FSS). If the audio test failed: 1. Make sure that the Patient Unit main cover and the User Interface rear cover are correctly mounted. Otherwise the audio tests may fail. 2. Check in the Test results-log (FSS) if it was the Panel test or the Monitoring test that failed: • If the Monitoring test failed: Replace PC 1772 Monitoring. • If the Panel test failed: Replace the loudspeaker or PC 1777 Panel.

Test	Test description *	Recommended action if the test fails
Internal tests (continued)		If the Alarm output connector test failed: 1. Replace PC 1789 Remote alarm connector. 2. Replace PC 1772 Monitoring If the power test failed: 1. Replace PC 1772 Monitoring.
Barometer test	Checks that the barometric pressure measured by the internal barometer is within 630–1080 hPa. Checks that the measured barometric pressure values differs less than 8 hPa between BRE and MON. (BRE + MON)	Check the Barometric pressure value in the Status window: If that value is within 630–1080 hPa: 1. Replace PC 1771 Control 2. Replace PC 1772 Monitoring 3. Replace PC 1784 Expiratory channel 4. Replace the gas modules. Replace one gas module at a time. If that value is outside 630–1080 hPa: 1. Replace PC 1772 Monitoring.
Gas supply pressure test	Checks that the gas supply pressures (Air and O_2) measured by the internal gas supply pressure transducers are within 200–650 kPa (2.0–6.5 bar). Checks that the measured supply gas pressure values differs less than 20 mbar between MON and BRE. (BRE + MON)	1. Check that the connected gas supply pressure (Air and O_2) is within the specified range. 2. Start the unit in a ventilation mode and check the alarms: • If an Air supply pressure-alarm is activated, replace the Gas module Air. • If an O_2 supply pressure-alarm is activated, replace the Gas module O_2. 3. Replace PC 1771 Control. 4. Replace PC 1772 Monitoring.

Test	Test description *	Recommended action if the test fails
Internal leakage test	Checks the internal leakage, with test tube connected, using the inspiratory and expiratory pressure transducers. Checks that the leakage at 80 cm H_2O is max. 10 ml/min. Checks that the measured pressure values differs less than 5 cm H_2O between Insp. and Exp. (BRE)	If message 'Leakage' or 'Excessive leakage' appears: 1. Check that the test tube is correctly connected. 2. Check the expiratory cassette: • Check that the cassette is correctly seated in the cassette compartment. • If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. • If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. To repair the old cassette, check that the expiratory valve membrane is clean and correctly seated in the cassette. Replace the membrane if required. 3. Check that the pressure transducer tubes/filters are correctly mounted. 4. Check the inspiratory section: • Check that the inspiratory pipe is correctly mounted in the inspiratory section. • Check that the safety valve membrane is clean and correctly seated in the inspiratory pipe. • Check that the safety valve closes properly when the Pre-use check is started (distinct clicking sound from the valve). If the safety valve opens during this test, the opening pressure may not be correctly calibrated (see 'Safety valve test' below). Run the 'Safety valve test' and repeat the complete Pre-use check.

Test	Test description *	Recommended action if the test fails
Internal leakage test (continued)		If message 'Pressure Transducer difference > 5 cm H_2O' appears: 1. Check that the pressure transducer tubes and the inspiratory filter are correctly mounted. 2. Check that both PC 1781 Pressure transducer (Insp. and Exp.) are correctly mounted. 3. If the 'Pressure transducer test' also fails (see below), refer to the recommended actions if 'Pressure transducer test' failed. If message 'System volume too small' appears: 1. Replace the gas modules. Replace one gas module at a time. If message 'System volume too large' appears: 1. Check that the correct test tube is used during the Pre-use check. 2. If the 'Flow transducer test' also fails (see below), replace the gas modules. Replace one gas module at a time. 3. Refer to troubleshooting as described for 'Leakage' or 'Excessive leakage' above.

Test	Test description *	Recommended action if the test fails
Pressure transducer test	Calibrates and checks the inspiratory and expiratory pressure transducers. The new zero value for the pressure transducers may not differ more than ±6 cm H_2O from factory calibration. With the inspiratory pressure transducers used as a reference, a new gain factor is set for the expiratory pressure transducer. The new gain factor may not differ more than ±5% from factory calibration. During this test, the different subsystems concerned are compared. The difference between the sub-systems must not be more than ±1 cm H_2O at 60 cm H_2O. Expiratory valve coil test. Measures offset and gain in the valve coil. (BRE + MON)	Check that System SW V1.03.01 (or later) is installed. Update System SW if required. Check the 'Test results'-log in the 'More detailed' mode. (FSS) If 'Pressure transducer test' failed: 1. Check the expiratory cassette: • If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. • If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. The fail with the old cassette may in this case be due to water collected at the pressure transducer filter inside the cassette. Dry the old cassette properly. 2. Check/replace PC 1781 Pressure transducer (Insp. and Exp.). To locate the faulty pressure transducer, replace one transducer at a time. 3. Replace PC 1771 Control. 4. Replace PC 1772 Monitoring. If 'Expiration valve test' failed: 1. Check the expiratory cassette: • If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. • If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. To repair the old cassette, check that the expiratory valve membrane is clean and correctly seated in the cassette. Replace the membrane if required. 2. Replace the Expiratory valve coil.

Test	Test description *	Recommended action if the test fails
Safety valve test	Checks and if necessary adjusts the opening pressure for the safety valve to 117 ±3 cm H_2O. Checks the hardware signals related to the safety valve functions. (BRE + MON)	1. Check the inspiratory section: • Check that the inspiratory pipe is correctly mounted in inspiratory section. • Check that the safety valve membrane is clean and correctly seated in the inspiratory pipe. 2. Replace the safety valve pull magnet. 3. Replace PC 1784 Expiratory channel. 4. Replace PC 1772 Monitoring.
O_2 cell test	Calibrates and checks the O_2 cell at 21% O_2 and 100% O_2. Checks if the O_2 cell is worn out. As different gas mixtures are used during this test, calibration and check of O_2 cell will not be performed if one gas is missing. (BRE + MON)	1. Check that the connected gas supply pressure (Air and O_2) is within the specified range. 2. Replace the O_2 cell. 3. Replace the gas modules. Replace one gas module at a time. 4. Replace PC 1771 Control. 5. Replace PC 1772 Monitoring.

Test	Test description *	Recommended action if the test fails
Flow transducer test	Checks the inspiratory flow transducer. Calibrates and checks the expiratory flow transducer. Calibrates at 60% O_2 and checks at 100% and 21% O_2. As different gas mixtures are used during this test, calibration of the expiratory flow transducer will only be performed if both gases are connected. The check using the connected gas, (100% alt. 21% O_2) will however be performed. The 'Flow transducer test' will pass if the result of this check corresponds to the old calibration factor from a previous Pre-use check. The same expiratory cassette must be used. The new calibration factor for the expiratory flow transducer may not differ more than -10% to +15% from factory calibration. During this test, the different subsystems concerned are compared. The difference between the subsystems must not be more than ±0.3 l/min. (BRE + MON)	1. Check that the connected gas supply pressure (Air and O_2) is within the specified range. 2. Check the expiratory cassette: • Check that the cassette is correctly seated in the cassette compartment. • If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. • If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. The fail with the old cassette may in this case be due to water collected at the pressure transducer filter inside the cassette. Dry the old cassette properly. 3. Replace the gas modules. Replace one gas module at a time. 4. Replace PC 1785 Expiratory channel connector. 5. Replace PC 1771 Control. 6. Replace PC 1772 Monitoring. 7. Replace PC 1784 Expiratory channel.
Battery switch test	Checks that the power supply switches to battery when mains power is disconnected. Checks that the power supply switches back to mains power when re-connected. This test will not be performed if: • Less than 10 min. backup time remains in the connected Battery module(s). • No Battery module is connected. (MON)	1. Check that the total remaining time for the Battery module(s) is >10 min. If not, allow the battery to charge and repeat the test. 2. Replace PC1775 Plug-and-play back-plane. 3. Replace the Battery module(s).

Test	Test description *	Recommended action if the test fails
Patient circuit leakage test	Checks the patient circuit leakage, with patient tubing connected, using the inspiratory and expiratory pressure transducers. Checks that the leakage at 50 cm H_2O is max. 80 ml/min. Will allow the system to calculate a compensation for circuit compliance (if the leakage requirements are met). (BRE)	If the internal leakage test (see above) has passed, the leakage is to be located to the patient circuit. Check for leakage or replace the patient circuit.
Alarm state test	Checks that no Technical error alarms are active during the Pre-use check. (MON)	Refer to section regarding Technical error alarms for further information.
External alarm system test	If the option Alarm Output Connector is enabled, the user can test the external alarm system. The external alarm output signal is activated and the user must verify the external alarm.	1. Check the external alarm system. 2. Replace PC 1789 Remote alarm connector. The result of the test does not affect the outcome of the Pre-use Check

Technical error codes

The table below shows recommended actions in case of Technical error alarms.

Some of the Error codes are intended only for R&D, not for field service. If so, the text 'N/A' is stated in the 'Recommended action'-column.

Error code	Error message / Possible cause	Recommended action
Monitoring		
1	POWER_FAILURE_MINUS_12_VOLTS_ TOO_LOW (i.e. < -13.2 V)	1. Replace PC 1778 DC/DC & Standard Connectors.
2	POWER_FAILURE_MINUS_12_VOLTS_ TOO_HIGH (i.e. > -10.8 V)	1. Check status of external battery (if connected). 2. Replace PC 1778 DC/DC & Standard Connectors. 3. Replace PC 1775 Plug-and-play back-plane.
3	POWER_FAILURE_12_VOLTS_TOO_LOW	1. Check status of external battery (if connected). 2. Replace PC 1778 DC/DC & Standard Connectors. 3. Replace PC 1775 Plug-and-play back-plane.
4	POWER_FAILURE_12_VOLTS_TOO_HIGH	1. Replace PC 1778 DC/DC & Standard Connectors.
5	POWER_FAILURE_24_VOLTS_TOO_LOW	1. Replace PC 1778 DC/DC & Standard Connectors. 2. Replace the gas modules. Replace one gas module at a time and check that this technical error code will not appear.
6	POWER_FAILURE_24_VOLTS_TOO_HIGH	1. Replace PC 1778 DC/DC & Standard Connectors.
7	INSP_VALVE_RANGE_ERR	1. Replace PC 1771 Control. 2. Replace PC 1772 Monitoring. 3. Replace the gas modules. Replace one gas module at a time and check that this technical error code will not appear.
8	TECH_ERR_INSP_PAUSE_HOLD_TIME_ EXCEEDED	1. Replace PC 1771 Control.
9	TECH_ERR_EXP_PAUSE_HOLD_TIME_ EXCEEDED	1. Replace PC 1771 Control.

Error code	Error message / Possible cause	Recommended action
10	VALVES_DISABLED	1. Replace PC 1784 Expiratory channel. 2. Replace PC 1771 Control. 3. Replace PC 1778 DC/DC & Standard Connectors. 4. Replace PC 1772 Monitoring.
11	SAFETY_VALVE_OPEN	1. Check inspiratory channel. 2. Replace safety valve pull magnet. 3. Replace PC 1784 Expiratory channel.
12	BRE_NODE_DISCON	1. Replace PC 1771 Control.
13	BRE_NODEID_CONFLICT	N/A
14	PANEL_NODE_DISCON	1. Check the control cable 2. Replace PC 1777 Panel. 3. Replace PC 1778 DC/DC & Standard Connectors. Note: This error indicates communication failure between PC 1777 and PC 1772 and the error code will thus not be shown on the display (but will be logged).
15	PANEL_NODEID_CONFLICT	N/A
16	EXP_FLOW_MTR_NODE_DISCON	1. Replace PC 1784 Expiratory channel.
17	EXP_FLOW_MTR_NODEID_CONFLICT	N/A
18	N/A	N/A
19	N/A	N/A
20	N/A	N/A
21	N/A	N/A
22	BUZZER_SILENCER	1. Replace PC 1772 Monitoring.
23	N/A	N/A
24	BACKUP_CAP_ERR_MON	1. Replace PC 1772 Monitoring

Error code	Error message / Possible cause	Recommended action
25	TECH_MON_DEVICE_COMM_ERR	Depending on ID #. If repeated, replace parts as follows: 0: Report to MCC HSC for further information. 1: PC 1772 Monitoring. 2: PC 1775 Plug-and-play back-plane. 3: PC 1778 DC/DC & Standard Connectors. 4: PC 1781 Inspiratory pressure transducer. 5: PC 1781 Expiratory pressure transducer. 6: O2 cell or O2 cell cable or PC 1772 Monitoring. 32: PC 1784 Expiratory channel or PC 1772 Monitoring. 33: Gas module Air or PC 1772 Monitoring. 34: Gas module O2 or PC 1772 Monitoring. 35: PC 1772 Monitoring. 256: PC 1771 Control. 512: PC 1777 Panel. 784: N/A
27	TECH_ERR_BUZZER_FAILURE	1. Replace PC 1772 Monitoring. Note: If the Patient Unit front cover is removed, this error may be activated.
28	PANEL_AUDIO_FAIL	1. Replace the loudspeaker. 2. Replace PC 1777 Panel. Note: If the User Interface rear cover is removed, this error may be activated.
29	LITHIUM_BATTERY_LOW	1. Replace battery on PC 1772 Monitoring.
32	ALARM_ID_MISMATCH	N/A
33	BRE_NODE_CONNECT_TIMEOUT	1. Replace PC 1771 Control.
34	PANEL_NODE_CONNECT_TIMEOUT	1. Check the control cable. 2. Replace PC 1777 Panel. 3. Replace PC 1778 DC/DC & Standard Connectors. Note: This error indicates communication failure between PC 1777 and PC 1772 and the error code will thus not be shown on the display (but will be logged).

Error code	Error message / Possible cause	Recommended action
35	EXP_FLOW_MTR_NODE_CONNECT_TIME-OUT	1. Replace PC 1784 Expiratory channel.
36	N/A	N/A
37	EXP_FLOW_MTR_RANGE_ERR	N/A
38	BARO_UPPER_LIMIT_EXCEEDED	1. Check/calibrate barometer. 2. Replace PC 1772 Monitoring.
39	BARO_LOWER_LIMIT_EXCEEDED	1. Check/calibrate barometer. 2. Replace PC 1772 Monitoring. Note: This alarm will be activated if the ambient pressure is below 650 hPa, e.g. on a high altitude.
40	INVALID_METRIC	N/A
41	REAL_TIME_CLOCK_ERR	1. Check that System SW V1.02.05 (or later) is installed. Update System SW if required. 2. Replace PC 1772 Monitoring.
42	PERSISTENT_CHECKSUM_ERR	1. Restart the unit. 2. Replace PC 1772 Monitoring (if not Error code 29).
43	POWER_COMM_ERR	1. Replace the Battery module(s). 2. Replace PC 1775 Plug-and-play back-plane. 3. Replace PC 1772 Monitoring.
44	ALARM_LIM_XOR_ERR	1. Restart the unit. 2. Replace PC 1772 Monitoring (if not Error code 29).
45	ABNORMAL_SHUTDOWN	1. Restart the unit and run a Pre-use check. 2. Replace PC 1772 Monitoring.
46	REMOTE_ALARM_ERR	1. Replace PC 1789 Remote alarm connector. 2. Replace PC 1772 Monitoring.
47	N/A	N/A
48	PRE_OXYGEN_PHASE_TOO_LONG	1. Replace PC1771 Control.
49	DISCONNECT_PHASE_TOO_LONG	1. Replace PC1771 Control.
50	BACKPLANE_EEPROM_INVALID	1. Replace PC1772 Monitoring. 2. Replace PC1770 Main back-plane.

Error code	Error message / Possible cause	Recommended action
Breathing		
10001	BATTERY_MIN_VOLTAGE	1. Replace battery on PC 1771 Control.
10002	BRE_I2C_ERROR	1. Replace PC 1771 Control.
10003	BRE_FATAL_MEMORY_ERROR	1. Restart the unit. 2. Replace PC 1771 Control.

Panel		
20001	PANEL_DEVICE_ERROR	1. Replace PC 1777 Panel.
20002	PANEL_BACKLIGHT_BROKEN This error message may also be logged immediately before the 'No battery capacity' alarm when the unit is running in battery mode.	If the display is lit (and the error code is shown on the display): 1. Replace PC 1777 Panel. If the display is not lit (the display is dark): 1. Replace backlight lamps. 2. Replace PC board Backlight Inverter. Note: If one of the lamps is broken, the other lamp will automatically be switched off. Thus, with a failure on a backlight lamp, or likely also on PC board Backlight Inverter, the User Interface display will become dark. This error code will in such case not be possible to see (but will be logged).
20003	PANEL_BUTTON_STUCK	1. Restart the unit. Do not touch the User Interface during system start-up. Interfering the knobs, keys, touch screen, loudspeaker grid, etc, may affect the internal technical tests. 2. Check that System SW V1.03.00 (or later) is installed. Update System SW if required. 3. Check the user interface membrane buttons (FSS). 4. Replace the touch screen. 5. Replace PC 1777 Panel.

Error code	Error message / Possible cause	Recommended action
20004	PANEL_AUDIO_FAILED	1. Restart the unit. Do not touch the User Interface during system start-up. Interfering the knobs, keys, touch screen, loudspeaker grid, etc, may affect the internal technical tests. 2. Check that System SW V1.03.00 (or later) is installed. Update System SW if required. 3. Replace the loudspeaker. 4. Replace PC 1777 Panel.
20005	PANEL_PERSISTENT_CHECKSUM_ERR	1. Replace PC 1772 Monitoring.
Restart ventilator	Communication error between PC 1777 Panel and PC 1772 Monitoring.	1. Restart the ventilator and perform a Pre-use check. 2. Check the Control cable that connects the Patient Unit with the User Interface. 3. Replace PC 1778 DC/DC & Standard connectors. 4. Replace PC 1772 Monitoring.

Error code	Error message / Possible cause	Recommended action
Expiratory Flow Meter		
40001	Technical error in Exp flow meter. If the technical alarm 'Expiration flow meter PC 1784 60 V underrange' is logged together with error code 40001, see recommended action for this specific fault.	1. Replace the expiratory cassette. 2. Replace PC 1784 Expiratory channel. 3. Replace PC 1785 Expiratory channel connector. If technical alarm 'Expiration flow meter PC 1784 60 V underrange' is present: 1. Replace PC 1778 DC/DC & Standard Connectors.

Expiratory cassette		
Technical error in Expiratory cassette	Technical error in Expiratory cassette or in the communication with the cassette. If the technical alarm 'Expiration flow meter Exp. cassette power failure' is logged together with error code 'Technical error in Expiratory cassette', see recommended action for this specific fault.	1. Replace the expiratory cassette. 2. Replace PC 1785 Expiratory channel connector. 3. Replace PC 1784 Expiratory channel. If technical alarm 'Expiration flow meter Exp. cassette power failure' is present: 1. Replace PC 1778 DC/DC & Standard Connectors.

Notes

Only personnel trained and authorized by Maquet shall be permitted to perform installation, service or maintenance of the Servo-i.

Make sure to prepare the Servo-i properly before disassembling and assembling. Refer to section 'Hazard notices' in chapter 'Important'.

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

7. Preventive maintenance

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General

- A 'Preventive maintenance' must be performed at least once every year as long as the unit is not used more than normal. Normal operation is estimated to correspond to approx. 5,000 hours of operation.
- The Battery modules shall be replaced every three years.
- The internal Lithium batteries on PC 1771 and PC 1772 shall be replaced every five years.
- After or in combination with performing the 'Preventive maintenance' described in this chapter, a 'Routine cleaning' and an 'Extended cleaning of Inspiratory channel' must be performed.
  For cleaning procedures, refer to the 'Servo-i Ventilator System – User's manual'.
- In some parts of the Preventive maintenance, as described in this chapter, access to the Field Service System (FSS) is required.
- Some optional equipment used with the Servo-i, but not covered by this Service Manual, may also demand maintenance actions. Refer to the optional equipments documentation. Example on such optional equipment are:

  – Humidifier

  – Compressor Mini.

Preparations

- Make sure that the Servo-i works properly before performing any maintenance.
- Set the On/Off switch on the User Interface to Off.
- Disconnect the mains power cable.
- Disconnect the gas supplies (wall and/or cylinder).
- Remove patient tubing.
- If fitted, remove bacteria filter from the expiratory inlet.

Equipment

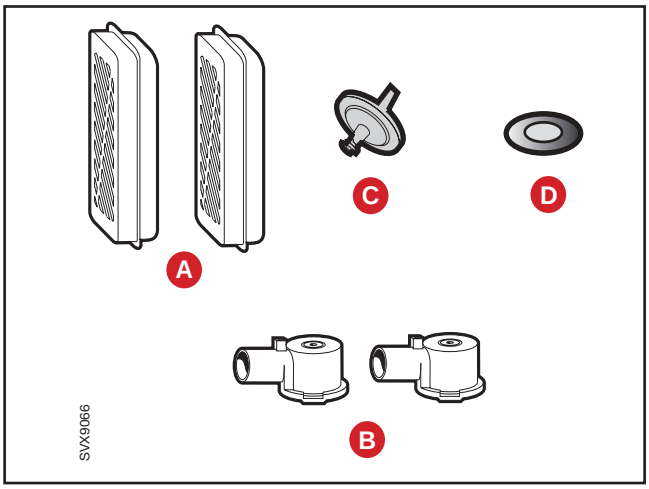
- Standard service tools.
- Barometer (or information about the actual barometric pressure).
- Access to the Field Service System (FSS). Recommended but not required.
- Preventive maintenance-kit containing all parts needed during the maintenance.

Preventive maintenance

Maintenance kit, 5,000 hours

Only original parts from the manufacturer must be used. Spare parts and maintenance kits can be ordered from your local Maquet representative.

When performing this maintenance, a 'Maintenance kit, 5,000 hours' should be used.



The following parts shall be replaced and they are included in the 'Maintenance kit, 5,000 hours':

A. Filters for the gas modules

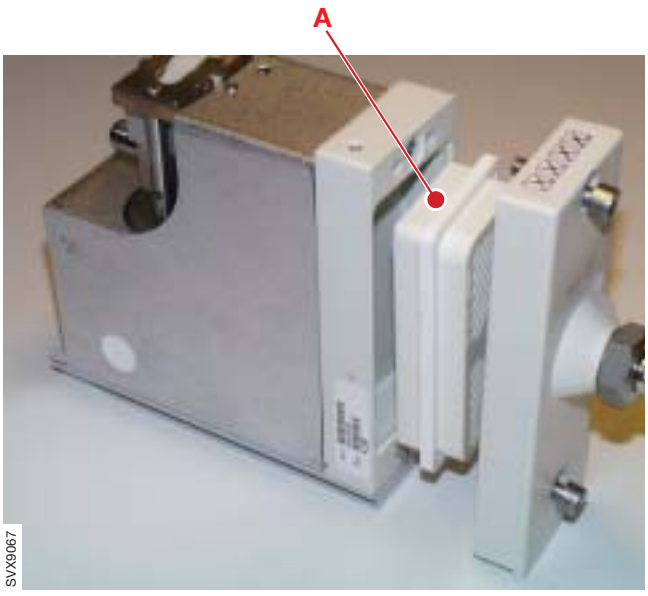
B. Nozzle units for the gas modules

C. Bacteria filter for the inspiratory pressure transducer

D. Bacteria filter for the O_2 cell

Performing the Preventive maintenance

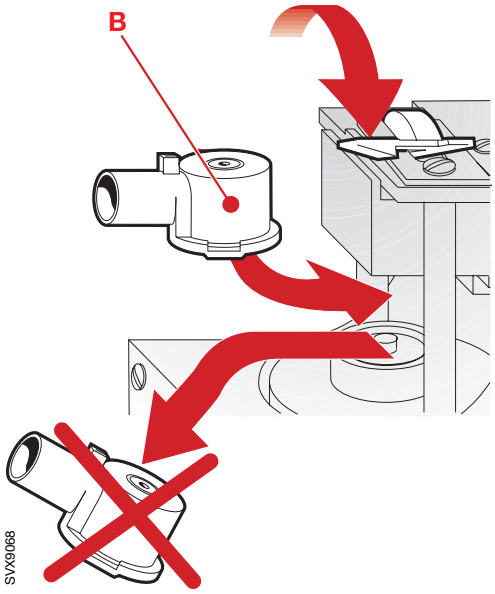
- Disassembling and assembling of the unit is required when replacing parts included in the 'Maintenance kit, 5,000 hours'. If not stated otherwise, refer to chapter 'Disassembling and assembling' for instructions.
- The letters A – D in the text below refers to the description of the Maintenance kit above.
- Prepare the unit as described in section 'Preparations' above in this chapter.



Gas modules

A. Replace filters in the gas modules. When replacing filter, move the rubber seal from the old to the new filter.

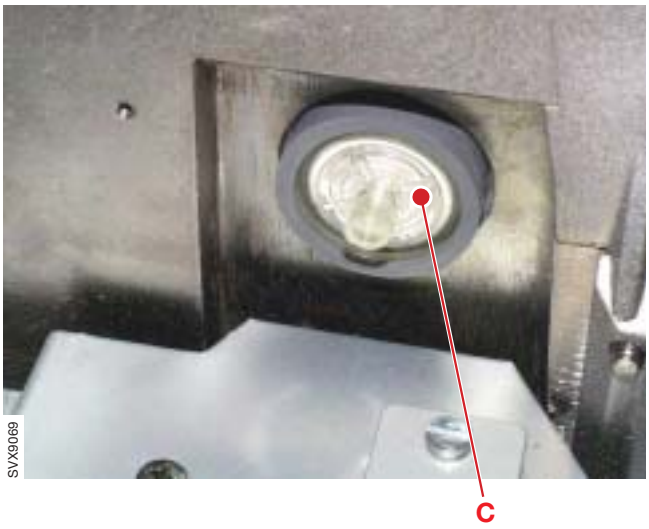
7



B. Replace plastic nozzle units in the gas modules.

After replacement of plastic nozzle units, wait 10 minutes before connecting pressure to the gas modules.

Inspiratory pressure transducer filter



C. Replace the filter for the inspiratory pressure transducer. Make sure that the filter is correctly seated into the rubber ring.

Refer to instructions in the 'Servo-i Ventilator System – User's manual', chapter 'Maintenance'.

Note: This filter may already be replaced as a part of the 'Extended cleaning of Inspiratory channel' performed in combination with the Preventive maintenance.

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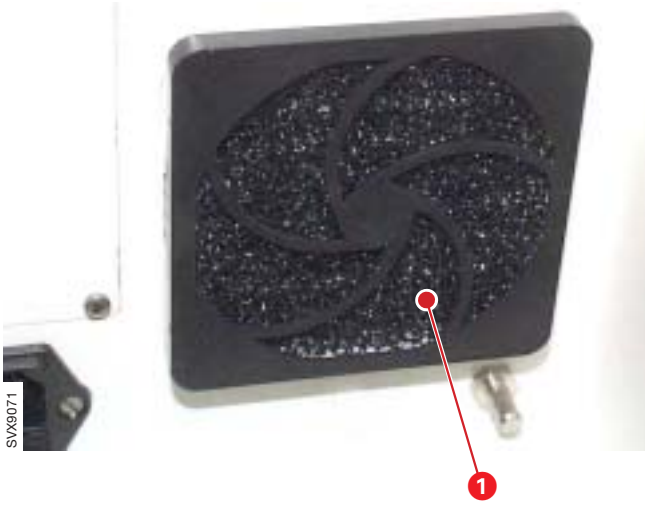
Bacteria filter for O_2 cell

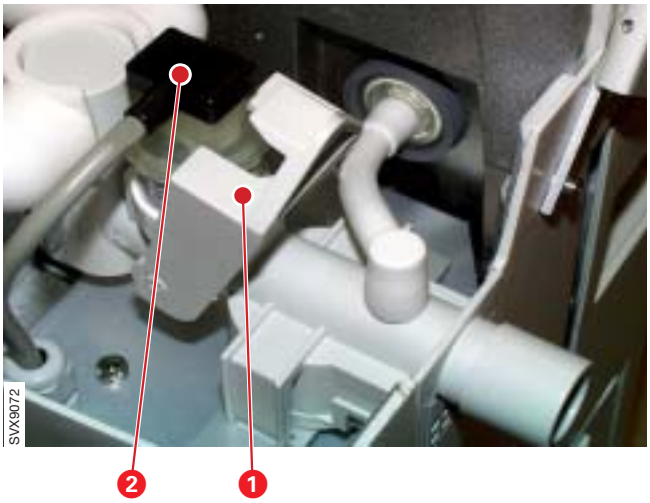
D. Replace the bacteria filter for the O_2 cell.

Refer to instructions in the 'Servo-i Ventilator System – User's manual', chapter 'Maintenance'.



Internal fan filter

- Remove the internal fan filter (1).
- Check if the filter is damaged. Replace damaged filter.
- If not damaged, clean the filter. The filter can be rinsed in water. Shake out and make sure that the filter is free from excess water.
- Mount the new/cleaned filter.



Internal fan

- Connect the mains power cable.
- Set the On/Off switch to Standby.
- Lower the locking catch (1) and disconnect the connector (2). This is done to protect the O_2 cell during the Internal fan-test.
- The temperatur sensor controlling the Internal fan is mounted in the cable connector (2). Carefully warm-up the cable connector (2) and check that the Internal fan starts. Use e. g. a light bulb or a heat fan to warm the connector.
- The Internal fan will start with half effect at approx. 33 °C (91 °F) and with full effect at approx. 43 °C (109 °F). **Note**: The temperature must not exceed 70 °C (158 °F).
- Re-connect the connector (2) and mount the inspiratory section cover.

It is also possible to check the Internal fan by running the unit in a ventilation mode and wait until the Internal fan starts. If this test method is used, all covers must be mounted in order to raise the temperature inside the compartment.

Expiratory cassette

- Remaining operating capacity (in %) for the membrane can be shown in the 'Status' window. Select Status / Exp. cassette to check 'Remaining membrane capacity'.
- When this capacity limit is passed or if the membrane for some reason has become defective, it must be replaced. Refer to instructions in chapter 'Disassembling and assembling'.
- The operating capacity meter must be reset after replacement of the membrane. To access the reset button, select Menu / Biomed / Service.

User Interface

- Check the touch screen readability:
  - Transparency
  - Surface
  - Brightness (backlight). Estimated lifetime (with acceptable brightness level) for the lamps is 30,000 hours. Using the Field Service System (FSS), a time meter for the lamps can be shown. The time meter must be reset after replacement of the lamps.
- Check if pixels on the touch screen are defective. Open the Status window. A few defective pixels can be accepted. Check that defective pixels are not concentrated to a small area thus reducing the readability in this area.
  FSS is recommended but not required.
- Perform the checks listed below and make sure that the software responds to these actions. FSS is recommended but not required.
  - Check the touch screen functions. Press buttons on different parts of the touch screen.
  - Check the Main Rotary Dial. Turn and press the Main Rotary Dial.
  - Check the Direct Access Knobs. Turn and press all Direct Access Knobs.
  - Check the membrane buttons. Press all membrane buttons.

Barometric pressure

- Select Status / General on the User Interface. Check that the Barometric pressure value shown on the User Interface corresponds to the actual Barometric pressure value at the local site. The value shown on the User Interface may not differ more than ±5% from the actual barometric pressure.
- If the value shown on the User Interface differs more than ±5% from the actual barometric pressure, the barometer in Servo-i must be calibrated. FSS is required.

Gas supply pressure transducers

- Connect the gas supplies (Air and O_2).
- Select Status / General on the User Interface.
- Disconnect the gas supply, one gas at the time.
- Check that the corresponding supply pressure value in the 'Status'-window drops.

Battery modules

- Check the status of the Battery modules used:
  - Check the manufacturing date of the Battery modules. Manufacturing date (year-week) is printed on the battery label. The batteries must be replaced after 3 years.
  - Check that the battery housing is not damaged.
  - Press the battery power symbol button and check that the green LEDs are lit. All 4 LEDs must be lit if the battery is fully charged.

If required, an extended check of the Battery modules can be performed. This extended check is described in chapter 'Service procedures'.

Lithium batteries

- Check manufacturing date for the lithium batteries mounted onto PC 1771 and PC 1772. The batteries must be replaced after 5 years. Replacement is described in chapter 'Service procedures'.

Safety inspection

- Make a visual inspection of the Servo-i for external defects or damages. Replace defective or damaged parts.
- Check the mains power cable and control cable and their connections for damage.
- Perform a leakage current test. The leakage current test is a standard procedure regulated by IEC 60 601-1 or corresponding national standards. Allowable values and test methods are defined in the standard. The use of a leakage tester, e. g. Bender Safety Tester 601/751 or equivalent is recommended.
- Check that a 'Servo-i Ventilator System – User's manual' and a 'Servo-i Ventilator System – Brief instructions' corresponding to the installed System SW version is present. Also check that operating manuals for all optional equipment connected to the Servo-i are present.

Completing the Preventive maintenance

- Perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's manual'.
- Perform 'Function checks' on the optional equipments connected to the Servo-i. Refer to the operating manuals for these optional equipments.
- Note in the Servo-i System SW (select Menu / Biomed / Service / Report PM) and also in a Servo-i log book that a Preventive maintenance has been performed.

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Make sure to prepare the Servo-i properly before disassembling and assembling. Refer to section 'Hazard notices' in chapter 'Important'.

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

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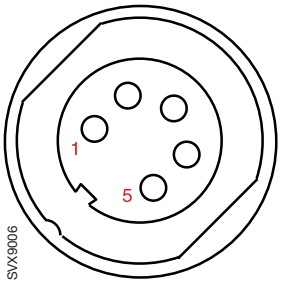
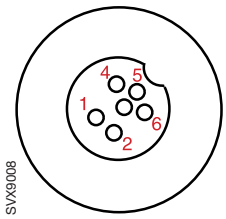
Standard and optional connectors



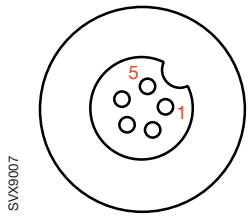
N26 – External +12 V DC supply input

1. +12V_UNREG_EXT_DC
2. +12V_UNREG_EXT_DC
3. –
4. GND
5. GND



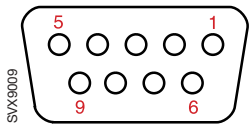
N28 / N70 – Control cable

1. +12V_UNREG_PANEL
2. GND
3. LED_CONTROL
4. ON_OFF_CONTROL
5. CAN_PANEL.H
6. CAN_PANEL.L



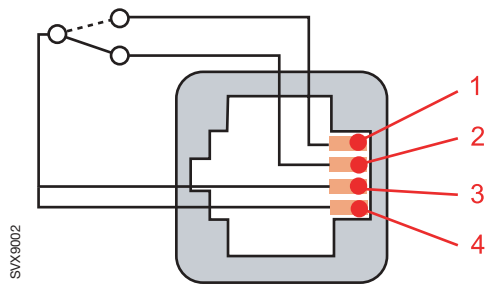
N27 – Optional equipment

1. GND
2. DISABLE_VALVES_EXT.L
3. CAN_EXPANSION.H
4. CAN_EXPANSION.L
5. +12V_UNREG_EXPANSION



N29 – RS232

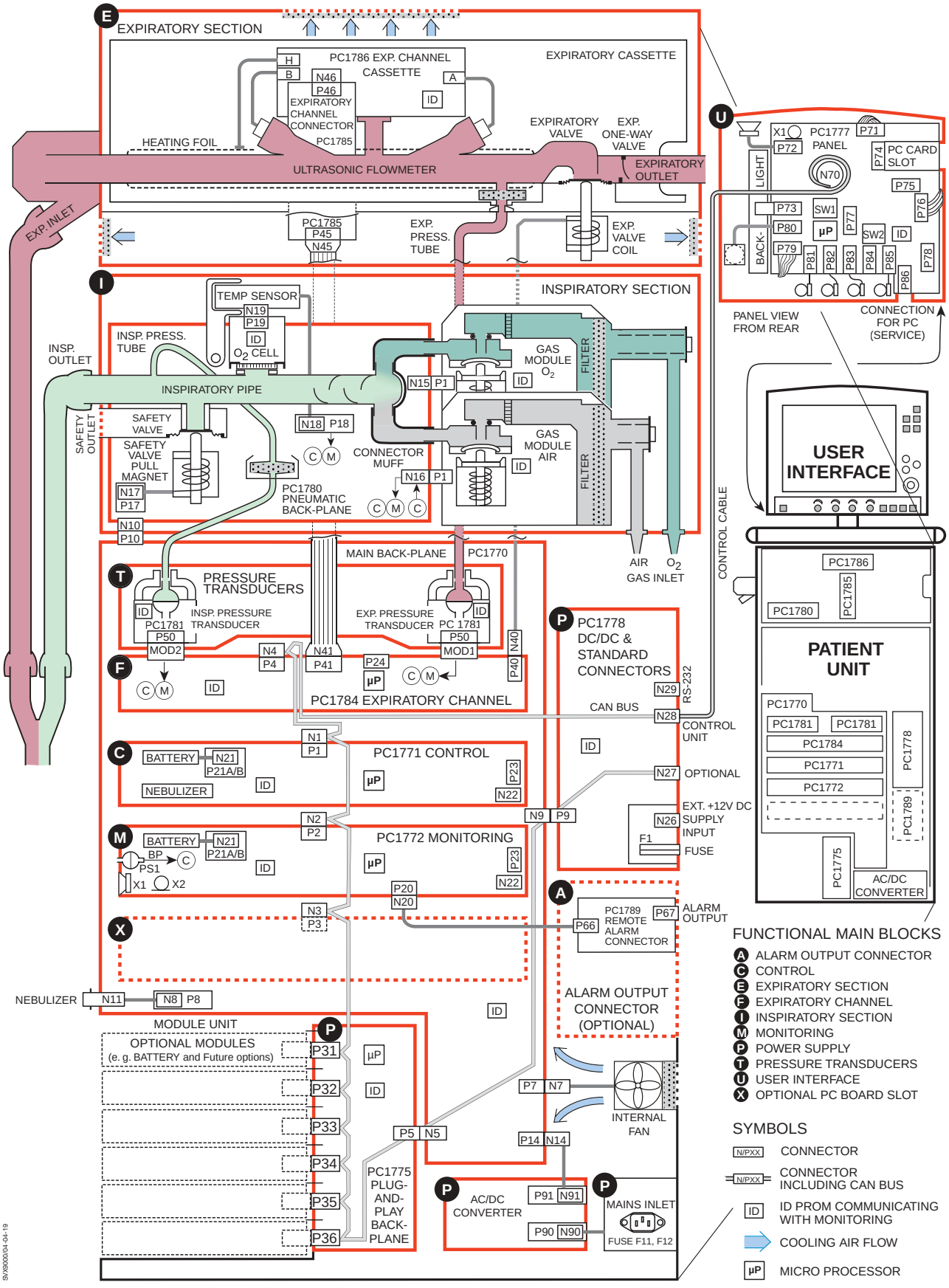
1. –
2. CI_RDX_ISO
3. CI_TDX_ISO
4. CI_DTR_ISO
5. GND_ISO
6. –
7. –
8. –
9. –



P67 – Alarm output connector (option)

1. NO – Normally Open
2. NC – Normally Closed
3. Common
4. Common

Functional Main Blocks diagram



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